WORKSHOP MANUAL

OVER

INTERNATIONAL HARVESTER

TRAKTOR

MODEL

B275-B414
354-364-384
424-444
2424-2444

SHOP MANUAL

INTERNATIONAL HARVESTER

SERIES B-275-B-414-354-364-384-424-444-2424-2444

All tractors are powered by four cylinder, four cycle engines. The Series B-275 tractors are equipped with a 144 cubic inch displacement diesel engine while the Series B-414 is available with either a 154 cubic inch displacement diesel engine or a 144 cubic inch displacement gasoline engine. Series 364 and 384 have a diesel 154 cubic inch displacement engine. Series 354 has a 144 cubic inch displacement engine in both diesel and gasoline models. Series 424 and 2424 are available with either a 154 cubic inch displacement diesel engine or a 146 cubic inch displacement gasoline engine. Series 444 and 2444 are available with either a 154 cubic inch displacement diesel engine or a 153 cubic inch displacement gasoline engine. A dual range transmission is standard equipment on all tractors and provides eight forward and two reverse speeds. In addition, the Series B-414, 364, 384, 424, 444, 2424 and 2444 tractors have available a forward and reverse transmission designed to work in conjunction with the main tractor transmission.

Engine serial number is stamped on a pad on right side of engine crankcase. Tractor serial number is stamped on a name plate on the right side of the clutch housing.

INDEX (By Starting Paragraph)

INDEX CONT.

CONDENSED SERVICE DATA

	Series B-275, 354 Diesel	Series 424, 2424, 444, 2444, B-414, 364, 384 Diesel	Series B-414, 354 Non-Diesel	Series 424, 2424 Non-Diesel	Series 444, 2444 Non-Diesel
GENERAL					
Engine Make	Own	Own	Own	Own	Own
Number of Cylinders	4	4	4	4	4
Bore—Inches	3-3/8	3½	3-3/8	3-3/8	3-3/8
Stroke—Inches	4	4	4	4-1/16	4¼
Displacement—Cubic Inches	144	154	144	146	153
Compression Ratio	19.3:1 (B-275) 20.1:1 (354)	23:1	6.3:1	7.6:1	7.7:1
Compression Pressure at 200 rpm Cranking Speed	330-335	445-470	80-105	180	180
Cylinder Sleeves Wet or Dry?	Wet	Wet	Wet	None	None
Forward Speeds—Number of	8	8	8	8	8
Main Bearings—Number of	5	5	5	3	3
Alternator, Generator and Regulator Make	Lucas	Delco-Remy (1)	Lucas	Delco-Remy	Delco-Remy
Starter Make	Lucas	Delco-Remy (1)	Lucas	Delco-Remy	Delco-Remy
Distributor Make	....	....	Lucas (2)	IH	IH

(1) B-414, 364 and 384 Lucas. (2) 354 Delco-Remy.

CONDENSED SERVICE DATA CONT.

	Series B-275, 354 Diesel	Series 424, 2424, 444, 2444, B-414, 364, 384 Diesel	Series B-414, 354 Non-Diesel	Series 424, 2424 Non-Diesel	Series 444, 2444 Non-Diesel
TUNE-UP					
Firing Order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
Valve Tappet Gap (Hot)	.020	.020	.020	—In. 0.014-Ex. 0.020—	
Valve Face and Seat Angle	45°	45°	45°	45°	45°
Breaker Contact Gap	....	....	0.014	0.020	0.020
Distributor Timing—Retard	....	....	5° BTDC	TDC	TDC
Distributor Timing—Advanced	....	....	39° BTDC	17° BTDC	17° BTDC
Timing Mark Location	Crankshaft Pulley	Flywheel	——— Crankshaft Pulley ———		
Injection Pump Make	C.A.V.	C.A.V.	....	....	....
Injection Pump Model	BPE or DPA	DPA	....	....	....
Injection Pump Timing—Static	20° BTDC	16° BTDC	....	....	....
Injection Nozzle Make	C.A.V.	C.A.V.	....	....	....
Injection Nozzle Model	BDN8S1(3)	BDN8S1(3)	....	....	....
Injection Nozzle Pop Pressure	See Par. 95	See Par. 95	....	....	....
Spark Plug Electrode Gap	....	....	0.024	0.023	0.023
Carburetor Make	....	....	Zenith	Marvel Schebler	Marvel Schebler
Carburetor Model	....	....	VNN or VNP	TSX896	TSX896
Engine High Idle Rpm	See	See	2200	2200	2200
Engine Rated Rpm	Paragraph	Paragraph	2000	2000	2000
Engine Low Idle Rpm	113	113	500-525	425	425
SIZES—CAPACITIES—CLEARANCES					
Crankshaft Main Journal Diameter	2.124-2.125	2.124-2.125	2.124-2.125	2.6235-2.6245	2.6235-2.6245
Crankshaft Rod Journal Diameter	1.7495-1.750	1.7495-1.750	1.7495-1.750	2.059-2.060	2.059-2.060
Piston Pin Diameter	1.1021-1.1024	1.1021-1.1024	1.1021-1.1024	0.8591-0.8593	0.8591-0.8593
Valve Stem Diameter	0.341-0.342	0.341-0.342	0.341-0.342	0.3405-0.3415	0.3405-0.3415
Rocker Arm Shaft Diameter	0.748-0.749	0.748-0.749	0.748-0.749	0.748-0.749	0.748-0.749
Camshaft Journal Diameter, No. 1	1.811-1.812	1.811-1.812	1.811-1.812	1.811-1.812	1.811-1.812
Camshaft Journal Diameter, No. 2	1.577-1.578	1.577-1.578	1.577-1.578	1.577-1.578	1.577-1.578
Camshaft Journal Diameter, No. 3	1.499-1.500	1.499-1.500	1.499-1.500	1.499-1.500	1.499-1.500
Main Bearings—Diametral Clearance	0.002-0.004	0.002-0.004	0.002-0.004	0.0009-0.0039	0.009-0.0039
Rod Bearings—Diametral Clearance	0.001-0.0029	0.001-0.0029	0.001-0.0029	0.0009-0.0039	0.0009-0.0039
Camshaft Bearings—Diametral Clearance	0.0015-0.0035	0.0015-0.0035	0.0015-0.0035	0.0009-0.0054	0.0009-0.0054
Piston Skirt Clearance	0.0031-0.0039(4)	0.0031-0.0039	0.0031-0.0039	0.001-0.002	0.001-0.002
Crankshaft End Play	0.004-0.008	0.004-0.008	0.004-0.008	0.004-0.010	0.004-0.010
Camshaft End Play	0.008-0.017	0.008-0.017	0.008-0.017	0.003-0.012	0.003-0.012
Cooling System—Quarts	10.8	10.8(5)	10.8(5)	13	13
Crankcase Oil—Quarts	8(6)	8.3	8(7)	5½	5½
Transmission and Differential—Quarts	20	20	20	20	20
Hydraulic Reservoir—Gallons	3	3	3	3	3
TIGHTENING TORQUES—FT.-LBS.					
Cylinder Head	75-80(8)	75-80	75-80	80-90	80-90
Main Bearing Bolts			See Paragraphs 70 and 80		
Connecting Rod Bolts	40-45(9)	40-45	40-45	43-49	43-49

(3) 354, 364 and 384—BDN-4SD.
(4) B-275—0.0048-0.0056. (5) B-414—9.5. (6) B-275—5.4. (7) B-414—5.
(8) B-275—70-75. (9) B-275—30-35.

FRONT SYSTEM

AXLE MAIN MEMBER

Series B-275-B-414-354-364-384

1. The axle main member pivots on pin (5—Fig. 1 or 2) which is retained in front axle support (7) by a groove pin or bolt (9). Diameter of pivot pin is 1.115-1.116. Press new bushing (4) into place and ream to 1.118-1.120. Normal operating clearance of pivot pin in the bushing is 0.002-0.005.

To renew the axle pivot pin and bushings on Series B-275 and B-414, raise hood and remove the cotter pins from rear of stay rod slides, then disconnect headlight wires from connectors located on forward side of front support. Unbolt and remove hood, being careful not to lose the two pivot spacers.

On Series 354, 364 and 384, remove hood, grille, grille support and front end weight support.

On models equipped with stay rod attachment, unbolt and remove stay rod ball socket cap (3—Fig. 3). Do not

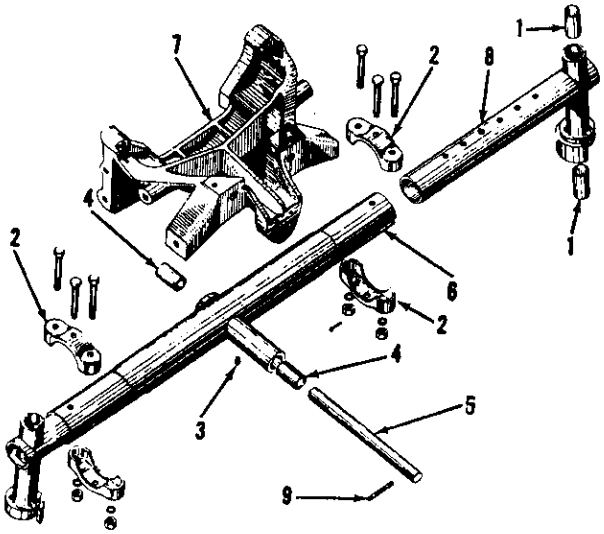


Fig. 1—Exploded view of Series B-275 adjustable front axle and component parts. Bushings (1 and 4) are pre-sized. Shims (10—Fig. 2) are also used with this axle.

1. Knuckle bushings
2. Axle clamps
3. Grease fitting
4. Pivot bushings
5. Pivot pin
6. Axle main member
7. Front support
8. Axle extension
9. Groove pin

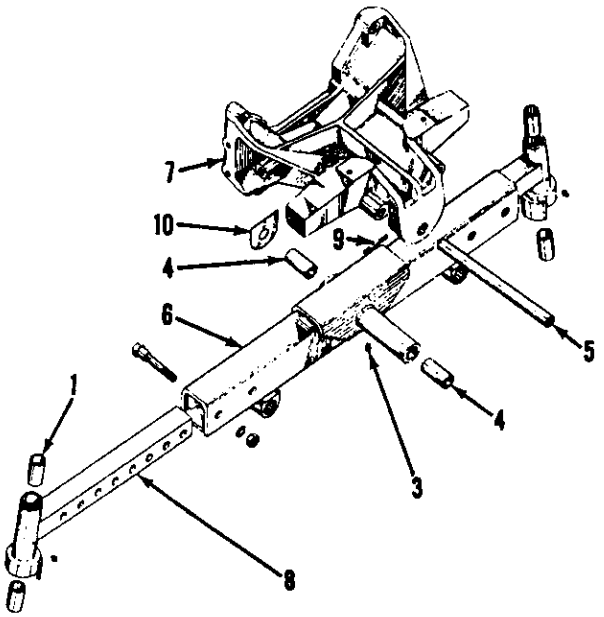


Fig. 2—Exploded view of Series B-414, 354, 364 and 384 adjustable front axle and component parts.

1. Knuckle bushings
3. Grease fitting
4. Pivot bushings
5. Pivot pin
6. Axle main member
7. Front support
8. Axle extension
9. Groove pin
10. Shims

damage shim (or shims) (4) between ball socket and socket cap.

On all models, disconnect drag link or power steering cylinder from left steering arm, then drive out the groove pin or bolt (9—Fig. 1 or 2) which retains axle pivot pin (5) in front support (7). Jack up tractor enough to take the weight off the front axle, drive pivot pin forward out of front support and remove the axle and wheels assembly. Do not damage the shim (or shims) which are between axle main member and front support. Shims are available in thicknesses of 0.002, 0.0032, 0.0048, 0.010, 0.028 and 0.030. Any further disassembly is evident.

Series 424-444-2424-2444

2. The axle main member (18—Fig. 4, 5 and 6) pivots on pin (17) which is retained in lower bolster (20) by a cap screw. The pre-sized pivot bushing (19) is pressed into position and can be removed after the axle main member has been removed from tractor. Normal clearance between pivot pin and bushing is 0.008-0.014.

To remove the axle main member assembly, support front of tractor using a jack under the clutch housing. Disconnect tie-rods from steering arm at center of tractor. On models equipped with standard axle (Fig. 4) or heavy duty axle (Fig. 6) and with power steering, disconnect hydraulic cylinders from axle main member. On models equipped with narrow tread axle (Fig. 5) and with power steering, unpin anchor end of cylinder and unbolt and remove lower cylinder arm (33). Remove cylinder or secure with wire on left side of tractor. Then on all models, adjust the height of the jack to

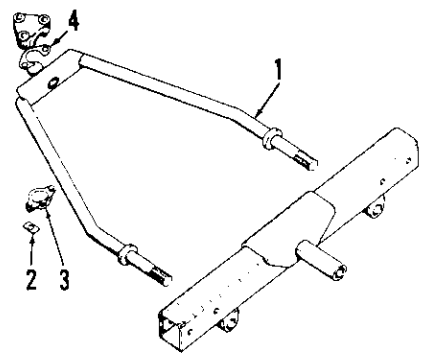
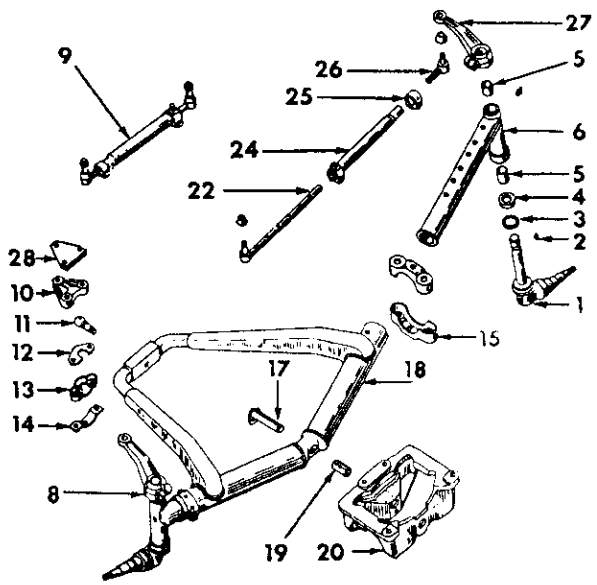


Fig. 3—Power steering stay rod attachment.

1. Stay rod
2. Lock plate
3. Socket cap
4. Shim

Fig. 4—Exploded view of Series 424, 444, 2424 and 2444 standard adjustable front axle and component parts.

1. Steering knuckle
2. Woodruff key
3. Felt washer
4. Thrust bearing
5. Bushing
6. Axle extension
8. Steering arm R.H.
9. Tie rod assy. (2 used)
10. Ball socket
11. Ball
12. Shim
13. Cap
14. Lock plate
15. Clamp
17. Pivot pin
18. Axle main member
19. Pivot bushing
20. Lower bolster
22. Tie rod extension
24. Tube
25. Clamp
26. Tie rod end
27. Steering arm L.H.
28. Spacer



remove weight from front tires. Remove pivot pin retaining cap screw and drive out pivot pin. Unbolt and remove stay rod ball socket cap (13). Raise front of tractor and roll front axle assembly forward from under tractor.

STEERING KNUCKLES

Series B-275-B-414-354-364-384

3. The steering knuckles can be removed from the axle extensions after steering arms and wheel assemblies have been removed.

After being pressed into place, ream inside diameter of new knuckle bushings (1—Fig. 1 or 2) to 1.359-1.360. Outside shaft diameter of new steering knuckle (8 or 11—Fig. 7) is 1.357-1.358. Operating clearance between knuckle shafts and bushings is 0.001-0.003. Use a piloted drift when installing bushings and install same with outer ends flush with bore.

Series 424-444-2424-2444

4. To remove the steering knuckles (1—Fig. 4 or 5) from tractors equipped with adjustable front axle, first support front of tractor and remove front wheel assemblies. Disconnect tie rods (9) from steering arms (8 and 27) and remove the arms from steering knuckles.

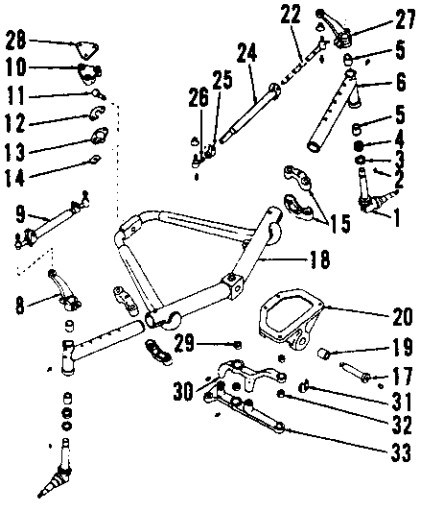


Fig. 5—Exploded view of Series 424, 444, 2424 and 2444 narrow tread adjustable front axle and component parts.

1. Steering knuckle
2. Woodruff key
3. Felt washer
4. Thrust bearing
5. Bushing
6. Axle extension
8. Steering arm R.H.
9. Tie rod assy.
10. Ball socket
11. Ball
12. Shim
13. Cap
14. Lock plate
15. Axle clamp
17. Pivot pin
18. Axle main member
19. Pivot bushing
20. Lower bolster
22. Tie rod extension
24. Tube
25. Clamp
26. Tie rod end
27. Steering arm L.H.
28. Spacer
29. Rear bushing
30. Cylinder arm (upper)
31. Pivot pin lock
32. Front bushing
33. Cylinder arm (lower)

Remove Woodruff keys and lower steering knuckles out of axle.

The procedure for removing steering knuckles (1—Fig. 6) from the non-adjustable heavy duty axle is the same as the adjustable axle with the following exceptions: The steering arms and steering knuckles are splined instead of having Woodruff keys. Snap rings (7) must also be removed before steering knuckles can be removed from axle.

Steering knuckle bushings (5—Fig. 4, 5 and 6) should be installed with a closely fitting mandrel and sized after installation, if necessary, to provide a recommended clearance of 0.002-0.004 for the steering knuckle.

When installing thrust bearings (4) on steering knuckles, make certain that open end of outer race is facing downward.

TIE-ROD, DRAG LINK AND TOE-IN

All Models

5. On early B-275 models the tie-rod and drag link ends are of the non-adjustable type and excessive wear is corrected by renewal of the complete tie-rod and/or drag link. On later B-275

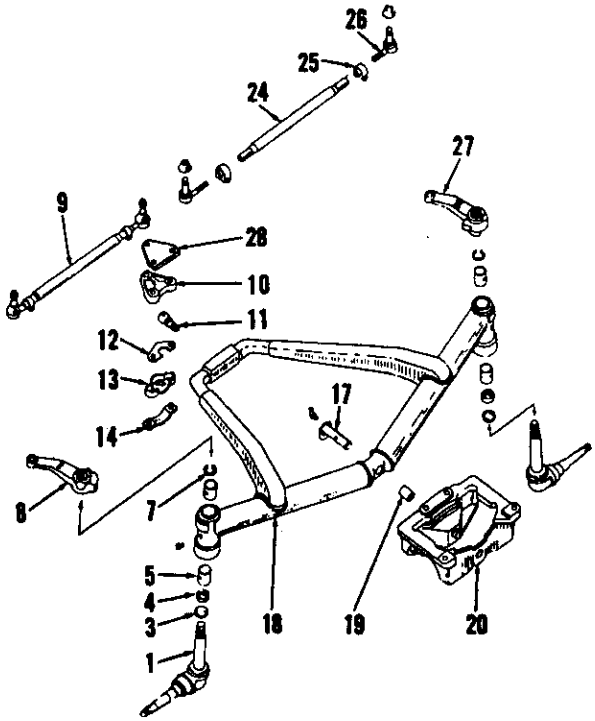


Fig. 6—Exploded view of Series 424, 444, 2424 and 2444 heavy duty non-adjustable front axle and component parts.

1. Steering knuckle
3. Felt washer
4. Thrust bearing
5. Bushing
7. Snap ring
8. Steering arm R.H.
9. Tie rod assy.
10. Ball socket
11. Ball
12. Shim
13. Cap
14. Lock plate
17. Pivot pin
18. Axle main member
19. Pivot bushing
20. Lower bolster
24. Tube
25. Clamp
26. Tie rod end
27. Steering arm L.H.
28. Spacer

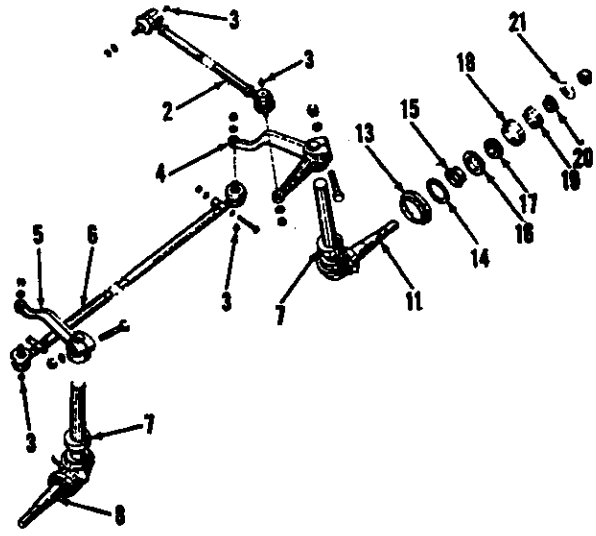


Fig. 7—Exploded view of Series B-275, B-414, 354, 364 and 384 steering knuckles, steering arms, tie rod and drag link used on models with no power steering. Models with power steering are similar.

2. Drag link
3. Grease fitting
4. L.H. steering arm
5. R.H. steering arm
6. Tie rod
7. Thrust bearing
8. R.H. steering knuckle
11. L.H. steering knuckle
13. Dust shield
14. Felt washer
15. Bearing spacer
16. Oil seal
17. Bearing cone
18. Bearing cup
19. Bearing cup
20. Bearing cone
21. Retainer washer

and all other models, component parts are available and can be purchased separately.

On Models B-275 and B-414, correct toe-in of ¼ to 3/8 inch is obtained by loosening the tie-rod clamps and rotating tie-rod either way as required. If necessary, adjust the drag link in a similar manner until there is equal contact at the stops when front wheels are turned full left and full right.

The correct toe-in for Models 354, 364, 414, 2424 and 2444 is 3/16 to 5/16 inch and 0 to 1/16 inch for Model 384. Both tie-rods must be adjusted equally so that full left and full right turning radius of the tractor will be the same.

STEERING GEAR

Series B-275-B414

The cam and lever steering gear assembly is provided with shim adjustments to compensate for wear of the steering worm (cam) shaft and the rocker shaft. The complete assembly is doweled and bolted to the clutch housing.

6. **ADJUST WORM SHAFT.** To adjust the steering worm shaft it is recommended that the unit be removed from tractor as follows:

Unlatch and raise hood, then remove the battery cover plate. Remove battery hold-down, disconnect battery cables and lift out batteries.

NOTE: Removal of left battery will be simplified if the hold-down studs are unscrewed from battery tray. It will also be easier to handle the fuel tank if the fuel is drained at this time.

Remove knob from fuel shut-off rod, then unbolt and remove the lower instrument panel. Remove filler panel from center of upper instrument panel then unbolt upper instrument panel and lay same on right hand foot plate.

NOTE: It is not necessary to disconnect the oil pressure line from gage providing care is exercised.

Remove steering wheel and if force is required, use a puller. Do not use a hammer. Disconnect link from lower end of hand throttle lever, then unbolt bracket and friction disc assembly from upper end of steering shaft tube and pull hand throttle lever from fuel tank tunnel. Straighten tabs of lock plates, then unbolt tank and move same up and over steering column. Disconnect fuel shut-off rod at forward end and remove. Remove the cross shaft to bell-crank control rod. Disconnect drag link from drop (Pitman) arm, then unbolt and remove steering gear assembly from tractor.

With assembly removed as outlined, vary shims under worm shaft end cap (15—Fig. 8) to provide zero end play of the worm shaft. Shims are available in thicknesses of 0.0024, 0.005 and 0.010.

7. **ADJUST ROCKER SHAFT.** Steering gear assembly need not be removed to adjust rocker end play. Remove side cover (1—Fig. 8) and vary shims (2) until a slight drag can be felt when steering gear passes through its mid (straight ahead) position. Disconnect drag link from drop (Pitman) arm when making this adjustment. Shims are available in thicknesses of 0.0024, 0.005 and 0.010.

8. **OVERHAUL.** To overhaul the steering gear assembly, first remove same as outlined in paragraph 6.

With unit removed, proceed as follows: Remove drop (Pitman) arm (6—Fig. 8) by using a suitable puller. Remove side cover (1) and be careful not to lose or damage shims (2). Rocker shaft (3) can now be removed.

NOTE: Do not drive on drop (Pitman) arm to remove it from rocker shaft as damage to internal parts could result. If a suitable puller is not available, remove side cover first, then drive rocker shaft from drop arm using the retaining nut, or some other means, to prevent damage to the rocker shaft threads.

Remove worm shaft end cover (15) and be careful not to damage or lose shims (14). Withdraw worm shaft (13) and bearing assemblies (10 and 11). Balance of disassembly is evident and will be dictated by the repair needed.

If new bushings (4) are installed, align ream same to an inside diameter of 1.2495-1.2510. If felt bushing (7) is renewed, it is recommended that the new felt bushings be soaked in warm graphite for 12 hours before installation. Oil seal (5) is installed with lip facing toward inside.

Reassemble by reversing the disassembly procedure. Adjust worm shaft to zero end play by varying shims (14) located under end cap (15). Adjust rocker shaft (3) by varying shims (2) under side cover (1) until a slight drag

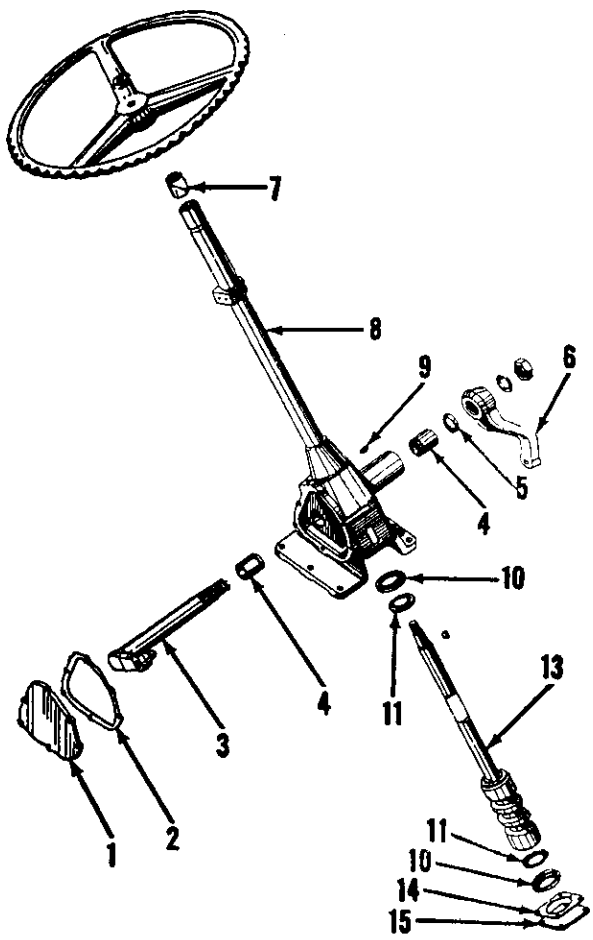


Fig. 8—Exploded view of Series B-275 and B-414 steering gear assembly showing the component parts and their relative positions.

1. Side cover
2. Shim (0.0024, 0.005, 0.010)
3. Rocker shaft
4. Bushings
5. Oil seal
6. Drop (pitman) arm
7. Felt bushing
8. Housing & tube
9. Filler plug
10. Bearing cup
11. Bearing
13. Cam (worm) shaft
14. Shim (0.0024, 0.005, 0.010)
15. End cover

is felt on steering wheel when gear passes through the straight ahead position. All shims are available in thicknesses of 0.0024, 0.005 and 0.010. Use paper gaskets on end cover (15) and side cover (1) when assembling. Torque drop arm retaining nut to 150 ft.-lbs.

Series 354-364-384

9. **R&R AND OVERHAUL.** To remove steering gear assembly, remove hood, battery and battery carrier. On diesel tractors remove leak-off pipe and shut-off lever. Close shut-off tap and disconnect fuel pipe and sender unit cable, then unbolt and remove fuel tank. Remove steering wheel, unbolt instrument panel and support from steering gear assembly, disconnect foot accelerator and necessary wires, lift unit up and set to one side.

NOTE: It is not necessary to disconnect oil pressure line from gage providing care is exercised.

Disconnect drag link from drop (Pitman) arm, then unbolt and remove steering gear assembly from tractor. With unit removed proceed as follows: Punch mating marks on the drop arm and rockershaft to aid assembly. Remove drop arm (13—Fig. 9) by using suitable puller, then remove side plate (16). Rockershaft (14) can now be removed. Remove the tube assembly (2) and being careful not to damage or lose shims (5), remove wormshaft (7) and bearing assembly.

After being pressed into place the inside diameter of new rocker shaft bushings (10—Fig. 9) is 1.3748-1.3758. Oil seal (11) is installed with lip facing toward inside.

Reassemble by reversing the disassembly procedure. Adjust worm shaft to zero end play by varying shims (5) located under tube assembly (2).

NOTE: Bearing must not be preloaded.

Adjust rockershaft (14) by turning thrust screw (18) in side cover (16) until a slight drag is felt on steering wheel when gear passes through the straight ahead position. Torque drop arm retaining nut to 150 ft.-lbs.

Series 424-444-2424-2444

The manual steering worm and worm wheel are located in the steering gear housing which is bolted to the front face of the engine. The center steering arm is keyed to the lower portion of the worm wheel shaft and the axle support (lower bolster) is retained to the steering gear housing by four cap screws. The manual steering unit is non-adjustable.

10. **REMOVE AND REINSTALL.** The steering gear housing, lower bolster and front axle assembly can be removed with radiator installed; however, some mechanics prefer to remove the radiator.

To remove steering gear housing with radiator attached, proceed as follows: Drain cooling system, remove hood and disconnect upper and lower radiator hoses. Disconnect the headlight wires and unbolt the radiator brace and fan shroud from radiator. Drive roll pin from forward yoke of steering shaft universal and remove cap screws from front steering shaft support. Drive front universal from steering worm shaft. Place wood blocks between steering gear housing and axle to prevent tipping. Using a suitable jack under the clutch housing raise front of tractor to remove most of the weight from the front tires. Unbolt the stay rod bracket from clutch housing the steering gear housing from front of engine. Raise engine until crankshaft pulley will clear steering gear housing, then roll complete front end assembly from tractor.

11. **OVERHAUL.** The steering gear can be overhauled without removing the assembly from tractor.

To remove the steering worm, proceed as follows: Remove hood, grille, side panels and grille housing and then, drain steering gear housing. Disconnect the steering shaft front universal from worm shaft and the steering shaft front support from the fuel tank bracket. Drive universal from worm shaft and remove the Woodruff key. Remove the steering worm retainer (5—Fig. 10) and turn worm shaft forward out of housing.

To remove ball bearing (7), remove cotter pin and nut and bump worm shaft out of bearing. When reinstalling the bearing on worm shaft, tighten nut to a torque of 75-120 ft.-lbs. Do not back off nut to below 75 ft.-lbs. to install cotter pin. Worm shaft bushing (11) and oil seal (12) can be renewed at this time. If needle bearing (10) is being renewed, it must be installed to the dimension shown in Fig. 11.

To remove the steering worm wheel and shaft assembly, proceed as follows: Disconnect the tie-rods from center steering arm and unbolt stay rod bracket from clutch housing. Place a jack under clutch housing to support front of tractor. Remove axle pivot pin, raise front of tractor and roll the front axle assembly forward. Unbolt and remove lower bolster from steering gear housing. Remove the cap screws retaining the worm wheel cage (21—Fig. 10) to steering gear housing and remove the worm wheel and shaft assembly. Remove center steering arm (23) and withdraw worm wheel and shaft (18). Bushing and oil seal can be renewed at this time. Oil seal is

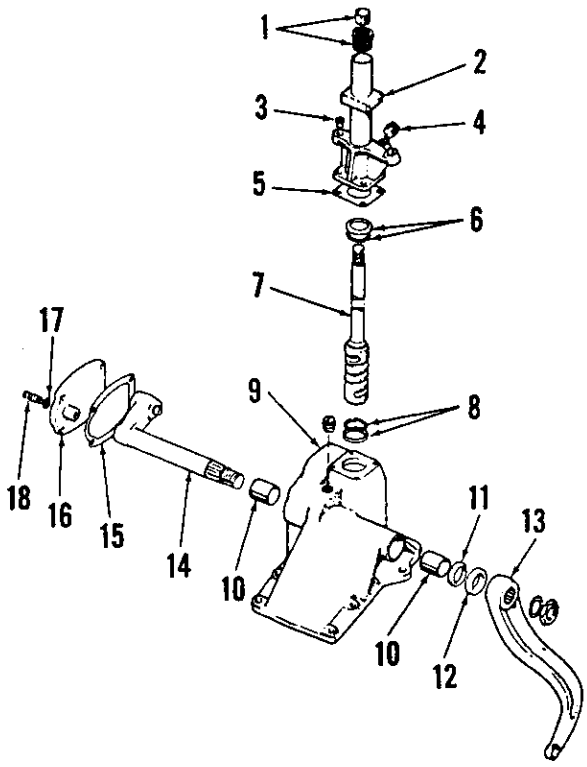


Fig. 9—Exploded view of Series 354, 364 and 384 steering gear assembly showing the component parts and their relative positions.

1. Bushing assy.
2. Tube assy.
3. Bushing
4. Oil level plug
5. Shims (0.0024, 0.005 & 0.010)
6. Bearing assy.
7. Shaft assy.
8. Bearing assy.
9. Housing
10. Bushings
11. Seal
12. Ring
13. Drop (pitman) arm
14. Rocker shaft
15. Gasket
16. Side cover
17. Locknut
18. Thrust screw

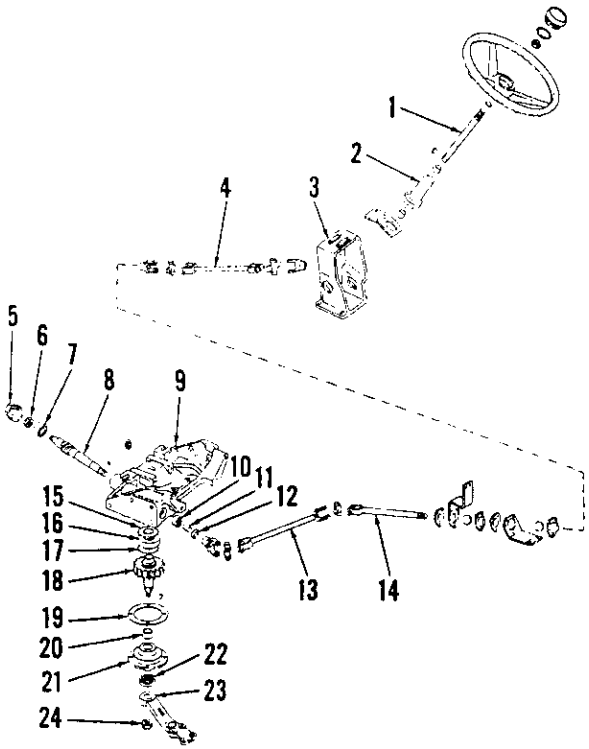


Fig. 10—Exploded view of mechanical steering gear assembly used on Series 424 and 444.

1. Rear steering shaft
2. Rear shaft support
3. Pedestal
4. Rear steering joint
5. Steering worm retainer
6. Nut
7. Ball bearing
8. Worm shaft
9. Steering gear housing
10. Needle bearing
11. Bushing
12. Oil seal
13. Front steering joint
14. Center steering joint
15. Shim (0.008)
16. Adapter
17. Shim (0.021 & 0.033)
18. Worm wheel
19. Gasket
20. Bushing
21. Cage
22. Oil seal
23. Center steering arm
24. Nut

installed with lip of same facing toward inside of steering housing. When reinstalling center steering arm, clamp the arm in a vise and tighten the retaining nut (24) to a torque of 200-250 ft.-lbs. If, when tightening the steering arm retaining nut, a castellation of the nut does not align with the cotter pin hold at some point between the specified 200-250 ft.-lbs. torque, continue to tighten nut. Do not back-off (loosen) nut to obtain alignment.

When reinstalling the worm wheel assembly, be sure large diameter of adater (16) is on top side. Install shims (15 and 17) as required to remove excessive end play of worm wheel and shaft assembly (18).

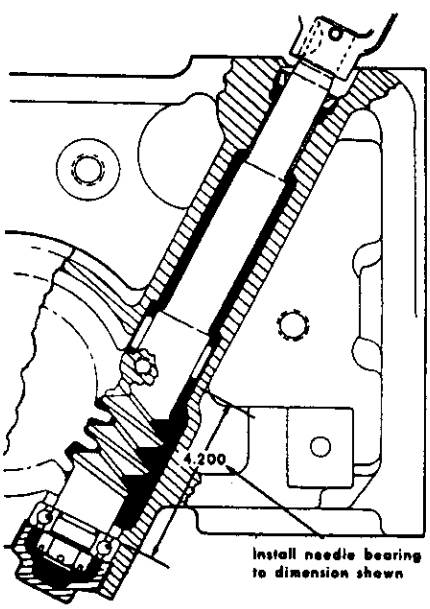


Fig. 11—When renewing needle bearing in Series 424 or 444 mechanical steering gear housing, install the bearing to dimension shown.

POWER STEERING

Series B-414-354-364-384

12. The power steering system used on B-414 prior to serial number 21196 is comprised of the steering gear assembly, a flow control valve and a power steering cylinder and control valve assembly. See Fig. 12 for a schematic view showing the general arrangement of the component parts. Pressurized oil for the operation of the power steering system is furnished by the same engine driven pump which supplies the hydraulic lift system.

Late production B-414 tractors (serial number 21196 and up) and all 354, 364 and 384 tractors are equipped with a dual stage pump and a relief valve block. Refer to Fig. 13. Flow control (divider) valve is not used on this system.

For information pertaining to the steering gear assembly, which is the same as that used on models with no power steering, refer to paragraphs 6 through 9.

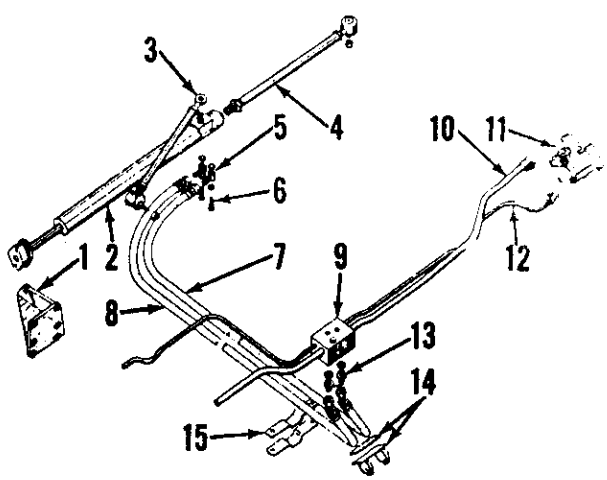


Fig. 12—View showing general arrangement of early Series B-414 power steering components.

1. Reaction bracket
2. Cylinder & valve assy.
3. Drag link
4. Connecting link
5. Banjo
6. Banjo bolt
7. Hose
8. Hose
9. Flow control valve
10. Suction line
11. Hydraulic pump
12. Pressure line
13. Adapter
14. Shield
15. Rubber insert

Series 424-444-2424-2444

13. A full time (Hydrostatic) power steering system is used on this series. Refer to Figs. 14 and 15 for a schematic view showing the general layout of components and tubing for the system.

NOTE: The maintenance of absolute cleanliness of all parts is of utmost importance in the operation and servicing of the hydraulic power steering system. Of equal importance is the avoidance of nicks or burrs on any of the working parts.

The power steering system is composed of the following components: An engine driven gear type pump, a flow divider valve, a spool type directional control valve, a gerotor type pump on the steering wheel shaft and two ram type single acting steering cylinders on models equipped with the standard axle (Fig. 4) or the heavy duty axle (Fig. 6) and one double acting cylinder on models equipped with narrow tread front axle (Fig. 5).

LUBRICATION AND BLEEDING

Series B-414-424-444-2424-2444-354-364-384

14. The hydraulic lift housing serves as the fluid reservoir for both the power steering system and the hydraulic lift system. Capacity of the reservoir is 3.0 gallons. Recommended fluid is IH "Hy-Tran" fluid.

To bleed the power steering system on B-414, 354, 364 and 384 tractors, fill reservoir to bottom of filler hole, start engine and cycle the steering system from lock to lock position until all air is bled from system. Recheck fluid level in reservoir and add fluid as required.

On Models 424, 444, 2424 and 2444, fill reservoir to proper level and then, start engine and run at low idle speed. Rotate steering wheel (hand pump) as rapidly as possible in order to activate the control valve and continue to rotate the steering wheel until the front wheels reach the stop in the direction in which the steering wheel is being turned. Now quickly reverse the direction of steering wheel and follow same procedure until front wheels reach stop in opposite direction. Continue to turn front wheels from lock to lock until steering wheel has no wheel spin (free wheeling) and has a solid feel with no skips or sponginess. Check and add fluid to reservoir, if necessary.

TROUBLESHOOTING

Series B-414-354-364-384

15. Some of the troubles that may arise in the operation of the power steering system and their possible causes are given as follows:

1. Loss of Power Assist.
   a. Fluid level low.
   b. Connections loose or damaged.
   c. Relief valve sticking.
   d. Power cylinder internal parts worn.
   e. Control valve sticking.
   f. Low pump output.
2. Binding.
   a. Power cylinder internal parts worn.
   b. Ball pin binding.
   c. Control valve sticking.
   d. Worn ball pin cups.
   e. Loose locating sleeve.
3. Heavy Steering.
   a. Relief valve sticking.
   b. Power cylinder internal parts worn.
   c. Control valve sticking.
   d. Worn ball pin cups.
   e. Loose locating sleeve.
   f. Low pump output.
4. Noisy Operation.
   a. Fluid level low.
   b. Relief valve sticking.
   c. Control valve sticking.
5. Steering Chatter.
   a. Worn piston rod ball cups.
   b. Loose reaction bracket.

Series 424-444-2424-2444

16. The following list shows some of the troubles, and their possible causes, which may occur in the operation of the Hydrostatic steering system.

1. No Power Steering or Steers Slowly.
   a. Excessive load on front wheels and/or air pressure low in front tires.

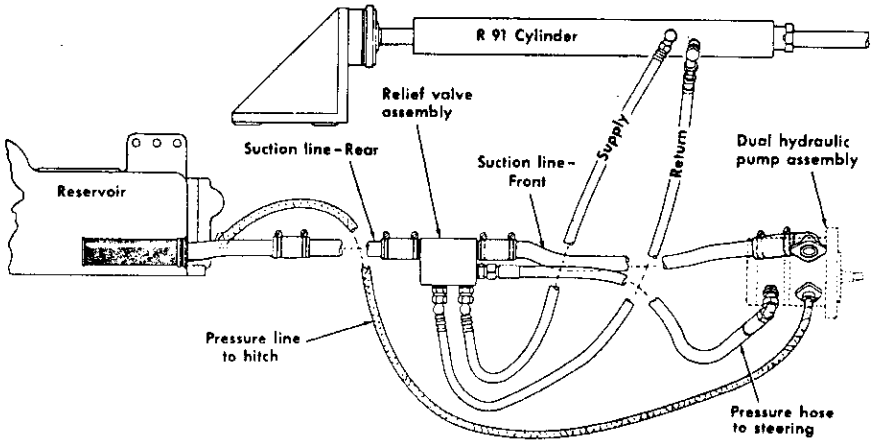


Fig. 13—View showing general arrangement of power steering components used on all Series 354, 364, 384 and Series B-414 S/N 21196 and later. On tractors equipped with R92 cylinder, supply and return hoses are connected to cylinder in reverse of connections shown.

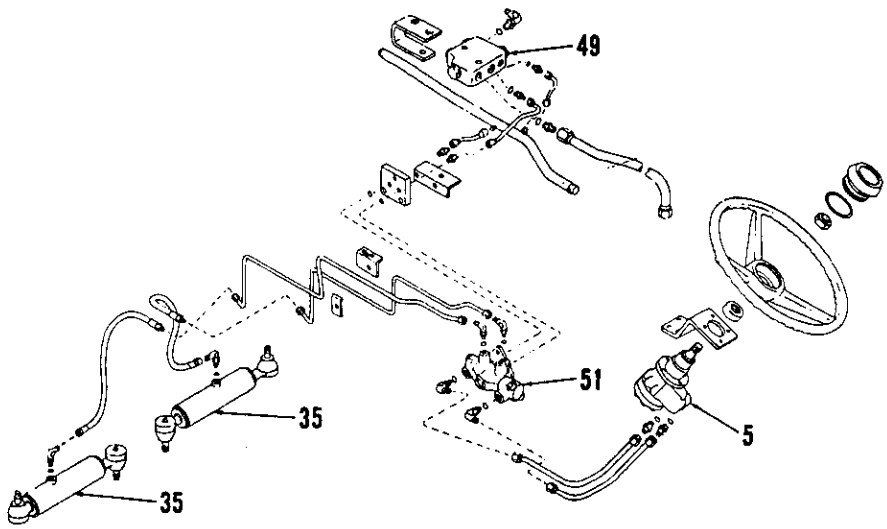


Fig. 14—Schematic view showing the general arrangement of the power steering system components of Series 424, 444, 2424 and 2444 used with front axles shown in Figs. 4 and 6.

5. Hand pump
35. Steering cylinder
49. Flow divider valve
51. Control (pilot) valve

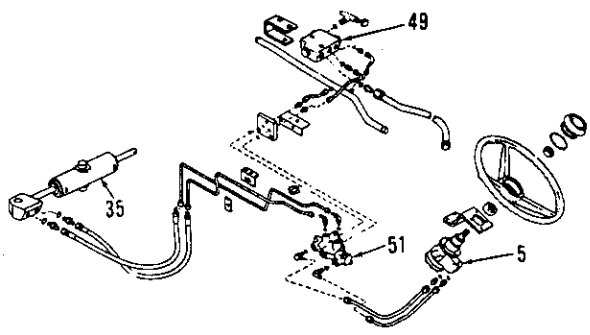


Fig. 15—Schematic view showing the general arrangement of the power steering system components used on Series 424, 444, 2424 and 2444 equipped with the narrow tread front axle shown in Fig. 5.

5. Hand pump
35. Steering cylinder
49. Flow divider valve
51. Control (pilot) valve

b. Steering cylinder faulty.
c. Faulty commutator in hand pump.
d. Flow divider valve spool sticking or leaking excessively.
e. Control (pilot) valve spool sticking.

2. Will Not Steer Manually.
a. Excessive load on front wheels and/or air pressure low in front tires.
b. Pumping element in hand pump faulty.
c. Steering cylinder faulty or damaged.
d. Pressure check valve leaking.
e. Control (pilot) valve spool binding or centering spring broken.

3. Hard Steering Through Complete Cycle.
a. Low pressure from supply pump.
b. Internal or external leakage.
c. Line between hand pump and control (pilot) valve obstructed.
d. Faulty steering cylinder.
e. Excessive load on front wheels and/or air pressure low in front tires.

4. Momentary Hard or Lumpy Steering.
a. Air in power steering circuit.
b. Control (pilot) valve sticking.

5. Shimmy.
a. Control (pilot) valve spring weak or broken.
b. Control (pilot) valve spring washers bent, worn or broken.

SYSTEM OPERATING PRESSURE

Series B-414-354-364-384

17. A pressure test of the power steering circuit can be made as follows: Connect a pressure gage, capable of registering at least 3000 psi, in series with the pressure line running to the power steering cylinder. Run engine and cycle steering system until fluid is at operating temperature, advance the engine speed to 2000 rpm, turn front wheels against either stop, continue to apply turning effort to steering wheel and observe the pressure gage reading which should be 900-1100 psi.

If pressure is as stated, hydraulic pump and relief valve can be considered satisfactory and any trouble is located in the power steering cylinder, control valve or connections.

If pressure is higher than stated, relief valve is probably stuck in the closed position and should be removed and cleaned or renewed. If pressure is lower than specified, remove and inspect relief valve assembly (items 6 through 10—Fig. 16 or items 13 through 19—Fig. 17). Spring (8—Fig. 16) should have a free length of 1.250 inches and test 21 lbs. when compressed to a length of 1.087 inches. Plug (6), spring (8), ball (9) and sleeve (10) are catalogued separately. Spring (15—Fig. 17) should have a free length of 2.250 inches and should test 47.5 lbs. when compressed to a lengh of 2.012 inches. If servicing the relief valve does not correct the pressure reading, overhaul hydraulic pump as outlined in paragraph 198 or 199.

Series 424-444-2424-2444

18. To check power steering operating pressure, refer to paragraph 34 which gives the method of checking the flow divider relief valve pressure.

POWER STEERING OPERATIONAL TESTS

Series 424-444-2424-2444

19. The following tests are valid only when the power steering system is completely void of any air. If necessary, bleed system as outlined in paragraph 14 before performing any operational tests.

20. MANUAL PUMP. With engine driven pump inoperative (engine not running), attempt to steer manually in both directions.

NOTE: Manual steering with engine driven pump not running will require high steering effort. If manual steering can be accomplished with engine driven pump inoperative, it can be assumed that the manual pump will operate satisfactorily with the engine driven pump operating.

Refer also to paragraph 22 for information regarding steering wheel (manual pump) slip.

21. CONTROL (PILOT) VALVE. Attempt to steer manually (engine not running). Manual steering will require high steering effort but if steering can be accomplished, control (pilot) valve is working.

No steering can be accomplished if control valve is stuck on center. A control valve stuck off center will allow steering in one direction only.

22. STEERING WHEEL SLIP TEST. Steering wheel slip is the term used to describe the inability of the steering wheel to hold a given position without further steering movement. Wheel slip is generally due to leakage, either internal or external, or a faulty hand pump, steering cylinder or control (pilot) valve. Some steering wheel slip, with hydraulic fluid at operating temperature, is normal and permissible. A maximum of three revolutions per min-

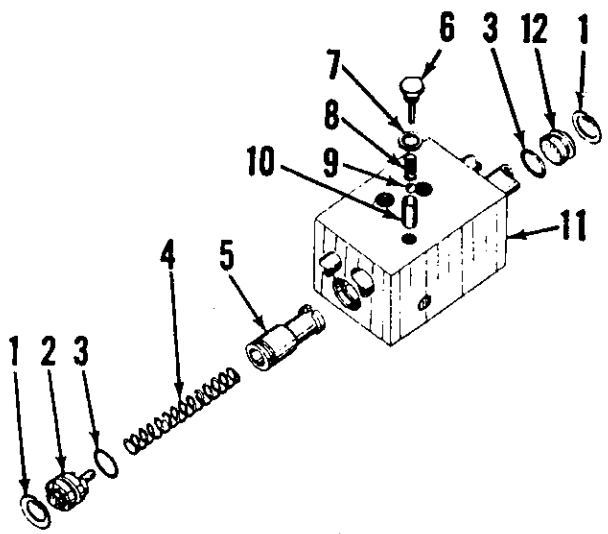


Fig. 16—Exploded view of early Series B-414 flow control and relief valve assembly used with single stage pump.

1. Snap ring
2. Plug
3. "O" ring
4. Spring
5. Flow control valve
6. Plug & pin
7. Seal washer
8. Spring
9. Relief valve ball
10. Valve guide
11. Valve body & tubes assy.
12. Plug

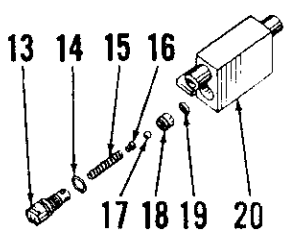


Fig. 17—Exploded view of Series B-414, 354, 364 and 384 power steering relief valve assembly used with dual stage pump.

13. Spring housing
14. "O" ring
15. Spring
16. Ball rider
17. Relief valve ball
18. Valve seat
19. Washer
20. Relief valve block

ute is acceptable. By using the steering wheel slip test and a process of elimination, a faulty unit in the power steering system can be located.

However, before making a steering wheel slip test to locate faulty components, it is imperative that the complete power steering system be free of air before any testing is attempted. Hydraulic fluid must also be at the correct level in reservoir.

To check for steering wheel slip, cycle steering system until all components and fluid are at operating temperature (150°F). Remove steering wheel cap (monogram), then turn front wheels until they are against stop. Attach a torque wrench to steering wheel nut.

NOTE: Either an inch-pound, or a foot-pound wrench may be used; however, an inch-pound wrench is recommended as it is easier to read.

Advance throttle until engine reaches 2000 rpm, then apply 72 inch-pounds (6 foot-pounds) to torque wrench in same direction as the front wheels are positioned against stop. Keep this pressure (torque) applied for a period of one minute and count the revolutions of the steering wheel. Use same procedure and check the steering wheel slip in the opposite direction. A maximum of three revolutions per minute in either direction is acceptable and system can be considered as operating satisfactorily. If the steering wheel revolutions per minute exceed three, record the total rpm for use in checking the steering cylinder on models equipped with double acting steering cylinder (Fig. 19).

NOTE: While three revolutions per minute of steering wheel slip is acceptable, it is generally considerably less in normal operation.

23. STEERING CYLINDER TEST. If steering wheel slip is more than three revolutions per minute on models equipped with double acting steering cylinder, check the steering cylinder for internal leakage as follows: Be sure operating temperature is being maintained, then disconnect and plug the steering cylinder lines. Repeat the steering wheel slip test, in both directions, as described in paragraph 22. If steering wheel slip is ½ rpm or more, **below** that recorded in paragraph 22, overhaul or renew the steering cylinder.

POWER STEERING CYLINDER AND CONTROL VALVE

Series B-414-354-364-384

24. **REMOVE AND REINSTALL.** To remove the power steering cylinder and control valve assembly, first disconnect hoses from cylinder and either plug hoses or suspend the disconnected ends high enough to prevent fluid drainage. Turn front wheels full left and full right several times to clear oil from cylinder and control valve. Disconnect drag link from ball pin, then disconnect cylinder from steering arm and reaction bracket and remove assembly from tractor.

CAUTION: Do not use a wedge or pinch bar to remove drag link from ball pin as damage to control valve could result. Use a puller.

When reinstalling, be sure anchor ball (50—Fig. 18) moves freely but without slack in its cups. Vary shims (52) to adjust anchor ball.

After cylinder and valve are installed, fill and bleed system as outlined in paragraph 14.

25. **OVERHAUL.** The overhaul procedure given is for the R91 steering cylinder. Overhaul procedure for the R92 cylinder is similar. The pressure and return ports are reversed on the

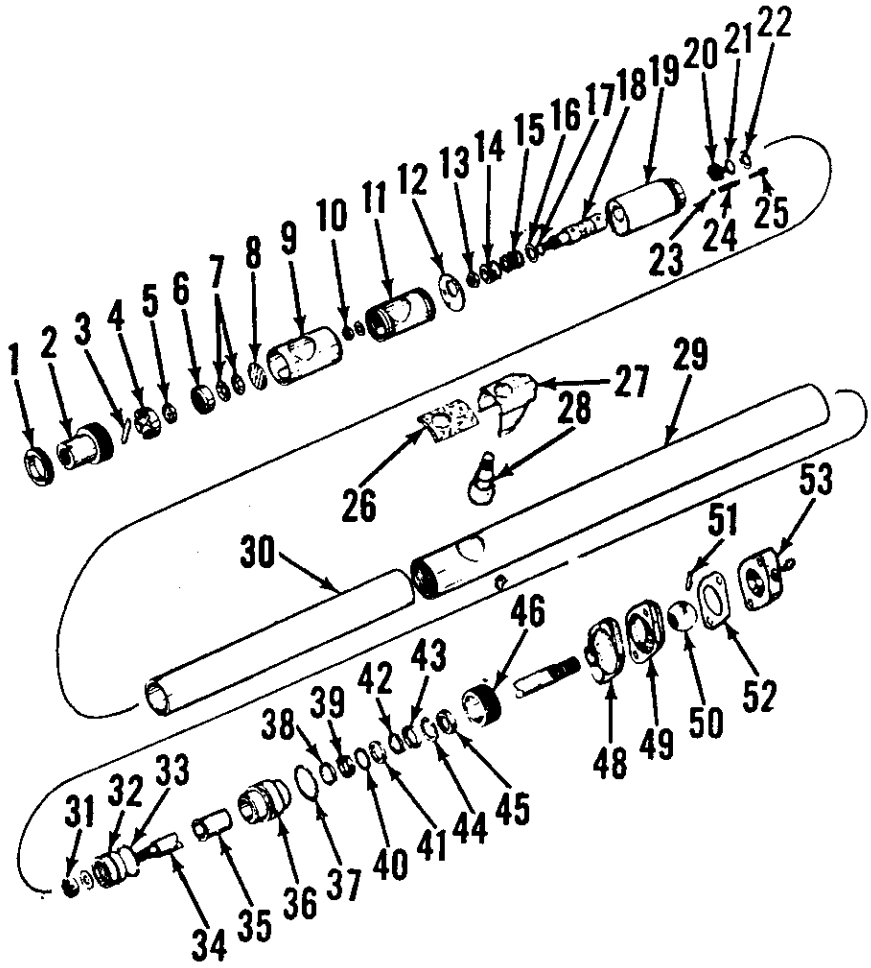


Fig. 18—Exploded view of Series B-414, 354, 364 and 384 power steering cylinder and valve assembly. Refer to Fig. 12 for view of connecting link which fits into take-off extension (2).

1. Lock ring
2. Take-off extension
3. Spring clip
4. Ball cup holder
5. Ball cup
6. Ball cup
7. Belleville washers
8. Backing washer
9. Locating sleeve
10. Nut
11. Operating sleeve
12. Spacer
13. Collar
14. Reaction ring
15. Reaction spring
16. Washer
17. "O" ring
18. Valve spool
19. Valve body
20. End cover
21. "O" ring
22. Snap ring
23. Relief valve ball
24. Spring
25. Plug & pin
26. Felt pad
27. Spring cover
28. Ball pin
29. Outer tube
30. Inner tube
31. Nut
32. Piston
33. Piston ring
34. Piston rod
35. Bushing
36. Bearing housing
37. "O" ring
38. Seal spreader
39. Gland seal
40. Vellumoid washer
41. Washer
42. Scraper
43. Scraper housing
44. Snap ring
45. Scraper
46. Lock ring
48. Rubber boot
49. Inner ball cup
50. Anchor ball
51. Pin
52. Shim
53. Outer ball cup

R92 cylinder and the by-pass valve is installed in the opposite end of valve body. The reaction ring was also eliminated on the R92 cylinder. With power steering cylinder and control valve assembly removed as outlined in paragraph 24, refer to Fig. 18 and proceed as follows: Drive pin (51) from anchor ball (50) and remove anchor ball, inner ball cup (49) and rubber cover (48) from piston rod. Remove cotter pins from cylinder ends. Remove bearing lock ring (46), then pull piston and bearing assembly (36) from cylinder. Remove retaining nut and washer and remove piston (32) from piston rod, then remove bearing assembly (36) from piston end of piston rod. Snap ring (44), scraper (45) and seal assembly (items 38 through 43) can now be removed from bearing assembly (36).

Loosen jam nut and remove connecting link from forward end of cylinder. Remove spring cover (27) and felt pad (26). Remove lock ring (1) and take-off extension (2), then remove spring clip (3), ball cup holder (4) and ball cup (5). Remove ball pin (28) from end of cylinder, then remove ball cup (6), Belleville washers (7) and backing washer (8). Remove control valve and inner tube (30) assembly from outer tube (29) and remove inner tube from control valve body. Remove the cotter pin, nut (10) and washer from forward end of spool (18). The operating sleeve (11), spacer (12) and collar (13) can now be removed. Remove reaction ring (14), spring (15), washer (16) and "O" ring (17) from spool. Remove snap ring (22), end cover (20) and "O" ring. Remove relief valve plug and pin (25), spring (24) and ball (23).

26. Thoroughly clean all parts and inspect for wear and/or damage.

Inspect spool and valve body for burrs and scoring. Burrs can be removed using crocus cloth or very fine emery cloth. Fit of spool in body is considered satisfactory when spool will fall freely by its own weight into the valve body when coated with a light film of oil.

NOTE: Valve spool and body are not catalogued separately and must be purchased as a mated pair.

Use caution when depressing spool not to round off any of the sharp edges. To do so may affect the operation of the valve.

Inspect the mating surfaces of the operating and locating sleeves and remove any burrs or scoring with crocus cloth or very fine emery cloth. The operating sleeve should slide freely in the locating sleeve when coated with a light film of oil.

Inspect the inner tube, piston, piston ring, piston rod and bearings for signs of wear, scoring and distortion. Renew as necessary.

NOTE: Piston rod (34), bushing (35), bearing housing (36), anchor ball (50) and anchor ball pin (51) are not available separately.

Inspect anchor ball, anchor ball pin and anchor ball cups for signs of wear or hammering and renew as necessary.

Use all new "O" rings when reassembling.

27. To reassemble the power steering cylinder and control valve assembly, the following procedure is recommended: Install relief valve ball and spring in valve body and tighten the plug and pin assembly securely. Any renewal of dowel pins can be accomplished by driving the new pins into place. Install new "O" ring on end cover (20) of valve body end cover, then install end cover in valve body and secure with snap ring (22). Install inner tube (30) on valve body and be sure slot in inner tube mates with dowel of valve body. Place new "O" rings on forward end of valve spool and outside diameter of reaction ring, then install the washer, spring and reaction ring on spool and be sure the chamfers of reaction washer and reaction ring face valve spool. Install the collar on the threaded portion of spool, then install spacer over collar. Position spacer so that the holes in same align with corresponding holes and dowel pin in valve body. Assemble the operating sleeve on the collar, then install the steel washer and nut. Tighten nut to a torque of 110 in.-lbs. and install cotter pin. Lubricate the operating sleeve, then slide locating sleeve over same.

Install seal spreader into the piston rod bearing, flat side first; then, using the proper size socket, install gland seal. Start from piston end of piston rod and slide snap ring, scraper housing, square section scraper, flat washer and vellumoid washer on piston rod. Install bearing assembly on piston rod, install seals and washers in counterbore of bearing assembly and secure in place by installing snap ring. Install scraper. Install new "O" ring on outside diameter of bearing assembly.

Install piston ring on piston, then install piston to piston rod, flat side first and install washer and castellated nut. Tighten nut to a torque of 34-35 ft.-lbs. and install cotter pin.

NOTE: Do not overtighten nut or piston may distort and bind in tube.

Compress the piston ring and slide the piston rod assembly into the inner tube assembly as far as it will go, making sure shoulder of bearing assembly enters inner tube. Lubricate spool assembly and carefully slide same into valve body making sure small hole in spacer is located on the dowel of the valve body.

Slide the inner tube and valve assembly into the outer tube from the anchorage (aft) end. Align the hose ports radially. Screw piston rod bearing lock ring into outer tube until hose ports are also aligned longitudinally and a slot in the lock ring is aligned with cotter pin hole, then install cotter pin.

Install backing plate, chamfer side first, into the operating sleeve and be sure it is correctly seated. Place heavy grease on the Belleville washers and place them in recess of the rear ball cup with the convex sides together; then install ball cup and washers in the operating sleeve. Install ball pin, front ball cup, ball cup holder, spring clip and take-off extension. Tighten take-off extension until snug, then back-off ¼-turn. Install take-off extension lock ring, tighten and secure with cotter pin.

Install rubber cover and inner anchor ball cup on piston rod, then install anchor ball and retaining pin.

Mount power steering cylinder on tractor as outlined in paragraph 24. Fill and bleed power steering system as outlined in paragraph 14.

STEERING CYLINDER

Series 424-444-2424-2444

28. **DOUBLE ACTING CYLINDER.** To remove the double acting steering cylinder (Fig. 19), disconnect and immediately plug the hydraulic lines. Remove cap screws from lower steering arm (33—Fig. 5) and disengage cylinder from steering arms. Remove pin retaining anchor assembly (15—Fig. 19) to axle main member and remove cylinder assembly from tractor.

Move piston rod back and forth several times to clear oil from cylinder. Place end of piston rod which has the flats in a vise, then unscrew and remove anchor assembly (15). Remove cylinder head retaining ring (7) as follows: Lift end of retainer ring out of slot, then using a pin type spanner, rotate cylinder head (2) and work retainer ring out of its groove. Cylinder head and the piston and rod assembly (10) can now be removed from cylinder tube (12). Remove remaining cylinder head in the same manner. All seals, "O" rings and back-up washers are now available for inspection and/or renewal. Clean all parts in a suitable solvent and inspect. Check cylinder tube for scoring, grooving and out-of-roundness.

Light scoring can be polished out by using a fine emery cloth and oil, providing a rotary motion is used during the polishing operation. A cylinder tube that is heavily scored or grooved, or that is out-of-round, should be renewed. Check piston rod and piston for scoring, grooving and straightness. Polish out very light scoring with fine emery cloth and oil, using a rotary motion. Renew rod and piston assembly if heavily scored or grooved, or if piston rod is bent. Inspect piston ring (9) for frayed edges, wear and imbedded dirt or foreign particles. Renew piston ring if any of the above conditions are found.

NOTE: Do not remove "O" ring (8) located under the piston ring unless renewal is indicated as it is not necessary to renew this "O" ring unless it is damaged.

Inspect balance of "O" rings, back-up washers and seals and renew as necessary. Inspect bores of cylinder heads and renew same if excessively worn or out-of-round.

Reassemble steering cylinder as follows: Place "O" ring (14), with back-up washer (13) on each side, in groove at inner end of anchor assembly oil tube. Install piston rod "O" ring (11) in groove at threaded end of piston rod. Install wiper seal (1), back-up washer (3), "O" ring (4), back-up washer (5) and cylinder head "O" ring (6) to cylinder head, then install cylinder head assembly over threaded end of piston rod. Lubricate "O" ring and back-up washers on inner end of anchor assembly oil tube and carefully insert into threaded end of piston rod. Lubricate piston rod "O" ring (11) and push anchor assembly toward piston rod. As "O" ring on inner end of oil tube approaches the drilled hole (port) in piston rod (located near piston), use IHC tool FES 65, or equivalent, to depress "O" ring and washers so they will pass the port without being damaged. Screw anchor assembly onto piston rod and tighten to a torque of 150 ft.-lbs. Lubricate piston ring (9) and cylinder head "O" ring (6), then using a ring compressor, or a suitable hose clamp, install piston and rod assembly into cylinder tube. Install cylinder head in cylinder tube so hole in groove will accept nib of retaining ring. Position retaining ring and pull same into its groove by rotating cylinder head. Complete balance of assembly by reversing disassembly procedure.

Reinstall unit on tractor, then fill and bleed the power steering system as outlined in paragraph 14.

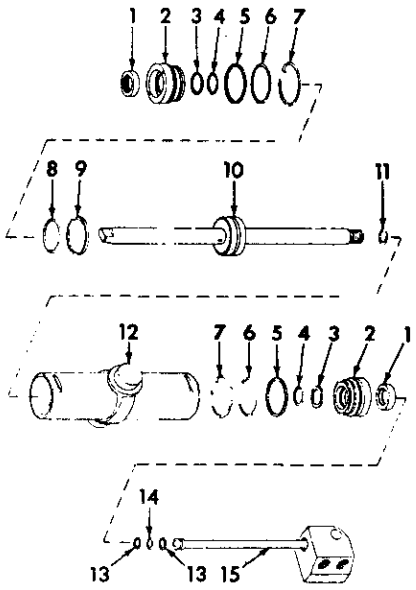


Fig. 19—Exploded view of double acting steering cylinder used on Series 424, 444, 2424 and 2444 equipped with narrow tread front axle.

1. Wiper seal
2. Cylinder head
3. Back-up washer
4. "O" ring
5. Back-up washer
6. "O" ring
7. Cylinder head retaining ring
8. Piston "O" ring
9. Piston ring
10. Piston & rod
11. "O" ring
12. Cylinder tube
13. Back-up washer
14. "O" ring
15. Anchor assy.

29. **SINGLE ACTING CYLINDERS.** To remove the single acting steering cylinders, disconnect the lines from steering cylinders and cap the lines to prevent dirt from entering system. Disconnect the cylinders from the center steering arm and axle main member, then remove the cylinders from tractor.

To disassemble the removed cylinders, pull the rod (5—Fig. 20) from the cylinder barrel (1). Normal service on the single acting cylinders consists of renewing the "O" ring (2), back-up washer (3) and wiper seal (4).

After reinstalling the cylinders, fill and bleed the system as outlined in paragraph 14.

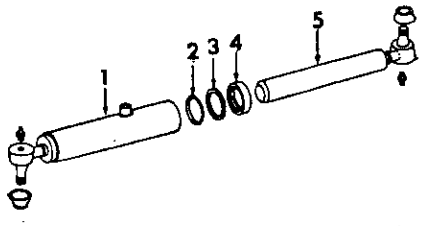


Fig. 20—Exploded view of a single acting cylinder used on Series 424, 444, 2424 and 2444 equipped with standard adjustable front axle or heavy duty non-adjustable front axle.

1. Barrel
2. "O" ring
3. Back-up washer
4. Wiper seal
5. Rod

HAND PUMP

Series 424-444-2424-2444

30. **REMOVE AND REINSTALL.** To remove the hand pump, remove steering wheel and panel below instrument panel.

NOTE: Use a puller to remove steer-

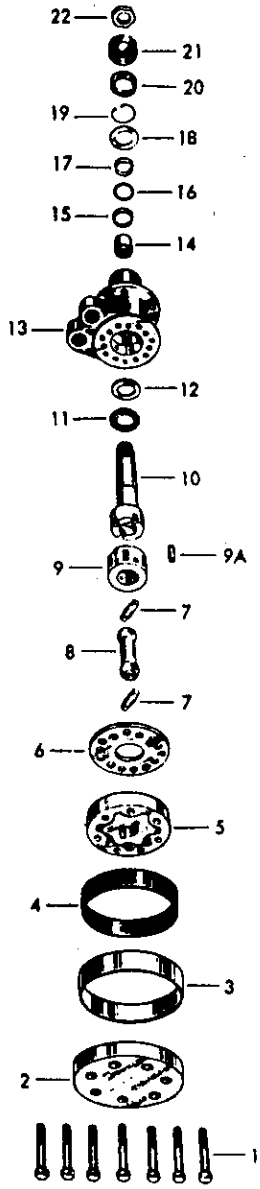


Fig. 21—Exploded view of power steering hand pump assembly.

1. Cap screws
2. End plate
3. Seal retainer
4. Seal
5. Rotor set
6. Spacer
7. Link pin
8. Drive link
9. Commutator
9A. Commutator pin
10. Coupling (input) shaft
11. Thrust bearing
12. Bearing race
13. Body
14. Needle bearing
15. Seal
16. Back-up washer
17. Spacer
18. Washer
19. Snap ring
20. Felt seal
21. Water seal
22. Wheel nut

ing wheel, do not bump on upper end of steering wheel shaft.

Disconnect lines from hand pump, then unbolt and remove hand pump from under instrument panel.

Reinstall by reversing the removal procedure and bleed power steering system as outlined in paragraph 14.

31. **OVERHAUL MANUAL (HAND) PUMP.** Remove the manual pump as outlined in paragraph 30. Clear fluid from unit by rotating steering wheel (input) shaft back and forth several times. Place unit in a soft jawed vise with end plate on top side, then remove end plate retaining cap screws and lift off end plate (2—Fig. 21).

NOTE: Lapped surfaces of end plate (2), pumping element (5), spacer (6), commutator (9) and pump body (13) must be protected from scratching, burring or any other damage as sealing of these parts depends only on their finish and flatness.

Remove seal retainer (3), seal (4), pumping element (5), link pin (7) and spacer (6) from body (13). Remove commutator (9) and drive link (8), with link pin (7) and commutator pin (9A), from body. Smooth any burrs or nicks which may be present on input shaft (10), wrap spline with masking tape, then remove input shaft from body. Remove bearing race (12) and thrust bearing (11) from input shaft. Remove snap ring (19), washer (18), spacer (17), back-up washer (16) and seal (15). Do not remove needle bearing (14) unless renewal is required. If it should be necessary to renew bearing, press same out pumping element end of body.

Clean all parts in a suitable solvent and if necessary, remove paint from outer edges of body, spacer and end plate by passing these parts lightly over crocus cloth placed on a perfectly flat surface. Do not attempt to dress out any scratches or other defects since these sealing surfaces are lapped to within 0.0002 of being flat. However, in cases of emergency, a spacer that is damaged on one side only may be used if the smooth side is positioned next to the pumping element and the damaged side is lapped flat.

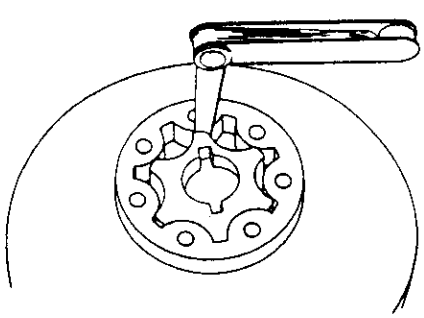


Fig. 22—Position pumping element as shown to check tooth clearance. Refer to text.

Inspect commutator and housing for scoring and undue wear. Bear in mind that burnish marks may show, or discolorations from oil residue may be present, on commutator after unit has been in service for some time. These can be ignored providing they do not interfere with free rotation of commutator in body.

Check fit of commutator pin in the commutator. Pin should be a snug fit and if bent, or worn until diameter at contacting points is less than 0.2485, renew pin.

Measure inside diameter of input shaft bore in body and outside diameter of input shaft bearing surface. If body bore is 0.006, or more, larger than shaft diameter, renew shaft and/or body and commutator.

NOTE: Body and commutator are not available separately.

Check thrust bearing and race for excessive grooving, flat spots or any other damage and renew bearing assembly if necessary.

Place pumping element on a flat surface and in the position shown in Fig. 22. Use a feeler gage and check clearance between ends of rotor teeth and high points of stator. If clearance exceeds 0.003, renew pumping element. Use a micrometer and measure width (thickness) of rotor and stator. If stator is 0.002 or more wider (thicker) than the rotor, renew the pumping element. **Pumping element rotor and stator are available only as a matched set.**

Check end plate for wear, scoring and flatness. Do not confuse the polish pattern on end plate with wear. This pattern, which results from rotor rotation, is normal. Renew end plate if worn or scored and is not within 0.0002 of being flat.

When reassembling, use all new seals and back-up washers. All parts, except those noted below, are installed dry. Reassemble as follows: If needle bearing (14—Fig. 21) was removed, lubricate with IH Hy-Tran fluid, install from pumping element end of body and press bearing into bore until inside end measures 3-13/16 to 3-7/8 inches from pumping element end of body as shown in Fig. 23. Lubricate thrust bearing assembly with IH Hy-Tran fluid and install assembly on input shaft with race on top side. Install input shaft and bearing assembly in body and check for free rotation. Install a link pin in one end of the drive link, then install drive link in input shaft by engaging the flats on link pin with slots in input shaft. Use a small amount of grease to hold commutator pin in commutator, then install commutator and pin in body while engaging pin in one of the long slots of the input shaft. Commutator is correctly installed when edge of commutator is slightly below sealing surface of body. Clamp body in a soft jawed vise with input shaft pointing downward. Again make sure surfaces of spacer, pumping element, body and end plate are perfectly clean, dry and undamaged. Place spacer on body and align screw holes with those of body. Put link pin in exposed end of drive link, then install pumping element rotor while engaging flats of link pin with slots in rotor. Position pumping element stator over rotor and align screw holes of stator with those of spacer and body. Lubricate pumping element seal lightly with IH Hy-Tran fluid and install seal in seal retainer, then install seal and retainer over pumping element stator. Install end cap, align screw holes of end cap with those in pumping element, spacer and body, then install cap screws. Tighten cap screws evenly to a torque of 18-22 ft.-lbs.

NOTE: If input shaft does not turn evenly after cap screws are tightened, loosen and retighten them again. However, bear in mind that the unit was assembled dry and some drag is normal.

If stickiness or binding cannot be eliminated, disassemble unit and check for foreign material, nicks or burrs which could be causing interference.

Lubricate input shaft seal with IH Hy-Tran fluid and with input shaft splines taped to protect seal, install seal, back-up washer, spacer, washer and snap ring. The felt washer and

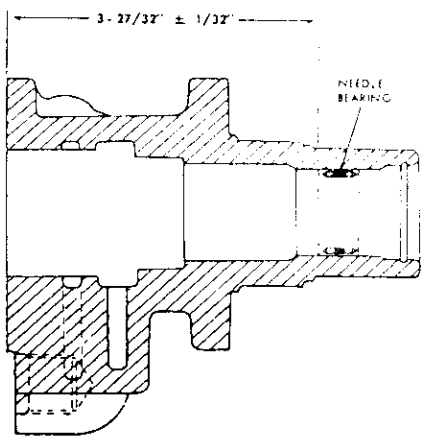


Fig. 23—When renewing needle bearing in pump body, install same to dimension shown.

water seal may be installed at this time but there will be less chance of loss or damage if installation is postponed until the time the steering wheel is installed.

After unit is assembled, turn unit on side with hose ports upward. Pour unit full of oil and work pump slowly until interior (pumping element) is thoroughly coated. Drain excess oil.

Reinstall unit by reversing the removal procedure and bleed power steering system as outlined in paragraph 14.

CONTROL (PILOT) VALVE

Series 424-444-2424-2444

32. **R&R AND OVERHAUL.** To remove the control (pilot) valve, drain the hydraulic reservoir and disconnect the hydraulic lines. Unbolt and remove the control (pilot) valve.

NOTE: **Plug hydraulic lines and openings immediately to prevent dirt from entering system.**

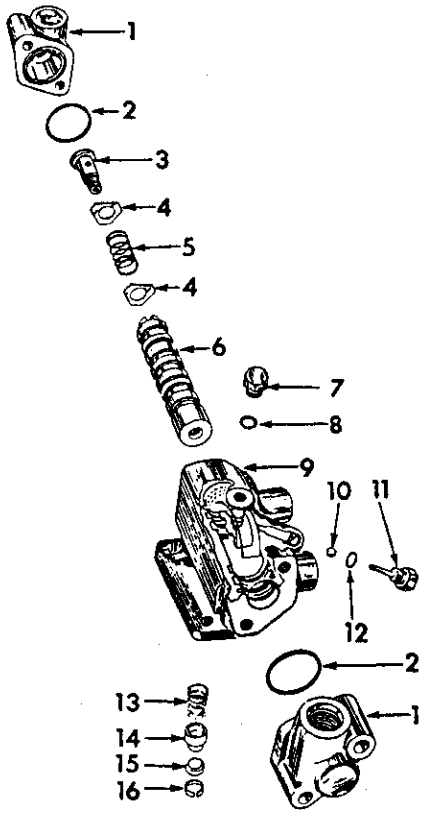


Fig. 24—Exploded view of the control (pilot) valve.

1. End cap
2. "O" ring
3. Centering spring screw
4. Centering spring washer
5. Centering spring
6. Valve spool
7. Plug
8. "O" ring
9. Valve body
10. Check ball
11. Plug
12. "O" ring
13. Spring
14. Check valve
15. Seal
16. Retainer

With valve removed, disassemble as follows: Refer to Fig. 24 and remove end caps (1) with "O" rings (2). Pull spool and centering spring assembly from valve body. Place a punch or small rod in hole of centering spring screw (3) and remove screw, centering spring (5) and centering spring washers (4) from spool. Remove plug (11), "O" ring (12) and circulating check ball (10). Remove retainer (16), seat (15), and pressure check valve (14) and spring (13).

Wash all parts in a suitable solvent and inspect. Valve spool and spool bore in body should be free of scratches, scoring or excessive wear. Spool should fit its bore with a snug fit and yet move freely with no visible side play. If spool or spool bore is defective, renew complete valve assembly as spool and valve body are not available separately.

Inspect pressure check valve and seat. Renew parts if grooved or scored.

Reassembly is the reverse of disassembly and the following points should be observed. Coat all parts with IH Hy-Tran fluid, or its equivalent, prior to installation. Install spool assembly in valve body so that centering spring is at end opposite the recirculating valve. Measure distance between gasket surface of circulating check ball plug and inner end of roll pin. This distance should be 15/16-inch, and if necessary, obtain this measurement by adjusting roll pin in or out. Tighten end cap retaining cap screws to a torque of 186 in.-lbs.

Reinstall valve by reversing removal procedure and bleed power steering system as outlined in paragraph 14.

FLOW DIVIDER VALVE

Series B-414

33. **R&R AND OVERHAUL.** Procedure for removal of the flow control valve and tubing assembly will be obvious after an examination of the unit.

Removal of relief valve (items 6 through 10—Fig. 25) can be accomplished by removing plug (6). Removal of flow control valve (5) and spring (4) can be accomplished after removal of snap rings (1) and plugs (2 and 12).

Free length of spring (4) is 3¾ inches and spring should test 18.0 lbs. when compressed to a length of 2-3/8 inches.

Spring (8) should have a free length of 1.250 inches and test 21.0 lbs. when compressed to a length of 1.087 inches.

Refer to paragraph 17 for method of checking the steering system operating pressure.

Series 424-444-2424-2444

34. **R&R AND OVERHAUL.** To remove the flow divider valve, first drain the hydraulic system, then disconnect the pump pressure hose, hitch supply pressure pipe, power steering supply pressure pipe and the relief valve return pipe. Unbolt and remove the flow divider valve assembly.

Remove plug (3—Fig. 26) and spool (2), then unscrew slotted plug (8) and withdraw relief valve spring (6) and relief valve (5).

Inspect all parts for scratches, scoring and undue wear. Relief valve spring free length should be 1.238 inches and should test 20-20.4 lbs. when compressed to a length of 63/64-inch. If

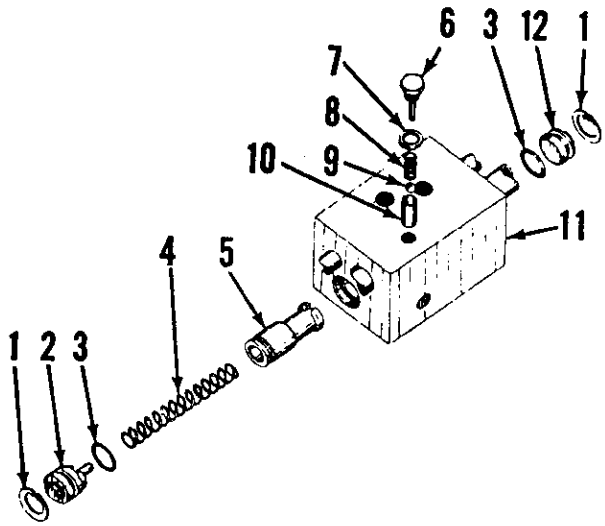


Fig. 25—Exploded view of Series B-414 flow control and relief valve used with single stage pump.

1. Snap ring
2. Plug
3. "O" ring
4. Spring
5. Flow control valve
6. Plug & pin
7. Seal washer
8. Spring
9. Relief valve ball
10. Valve guide
11. Valve body & tubes assy.
12. Plug

spool (2) or spool bore in valve body (1) is defective, renew complete valve assembly as spool and valve body are not available separately. Spool should move freely in its bore with no binding.

Coat all parts with Hy-Tran fluid, or its equivalent, and reassemble valve.

Reinstall valve by reversing removal procedure, then fill and bleed power steering system as outlined in paragraph 14.

To check the relief valve operating pressure proceed as follows: Disconnect a steering cylinder hose, then using a tee connector, install a gage capable of registering 3000 psi in this circuit. Start engine and run at 2000 rpm. Turn steering wheel in the direction needed to pressurize the steering line in which gage is installed. When wheels reach stop, continue to apply steering effort to steering wheel and note reading on the gage. The gage should read 1500-1600 psi. A too high reading indicates a stuck relief valve while a too low reading could be caused by a weak or broken relief valve spring or a worn or scored relief valve.

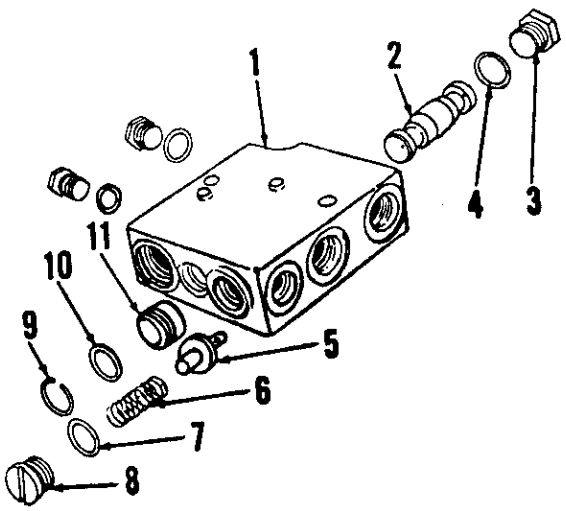


Fig. 26—Exploded view of the proportional type flow divider valve used on Series 424, 444, 2424 and 2444 tractors. Note the power steering relief valve (5).

1. Valve body
2. Spool
3. Plug
4. "O" ring
5. Relief valve
6. Relief valve spring
7. "O" ring
8. Plug
9. Snap ring
10. "O" ring
11. Plug

ENGINE AND COMPONENTS

R&R ENGINE WITH CLUTCH

Series B-275-B-414-354-364-384 Diesel

35. To remove the engine and clutch as an assembly, first drain cooling system, remove air cleaner cap and muffler, if equipped with vertical exhaust, then unlatch and raise hood. On Series B-275 and B-414 remove cotter pins from aft ends of the stay rod slides and move hood at a vertical position. Disconnect headlight wires at junction on front support, then remove hood pivot bolts and hood. Do not lose the two hood pivot bolt spacers. On Series 354, 364 and 384, remove the hood and radiator grille, disconnect the wiring from horn, disconnect ground lead and move the harness back on engine. On all series, disconnect drag link or power steering cylinder, if so equipped, from left steering arm. Disconnect upper and lower radiator hoses. Disconnect fuel filter bracket from radiator on Series B-275. Support tractor under clutch housing, then unbolt front support from engine and roll the front support, axle and radiator assembly away from tractor.

On Series B-275 and B-414 remove battery shield, battery hold-down and batteries. Remove battery carrier. On all series, if tractor is equipped with down swept exhaust, either remove the exhaust pipe from exhaust manifold or disconnect manifold from cylinder head. Disconnect tachometer cable, wires from generator, starter switch and number four glow plug, unclip wiring loom and lay wires rearward. Disconnect fuel shut-off rod at injection pump and remove rod. Close the fuel shut-off valve and disconnect fuel supply line from fuel pump. Disconnect oil pressure gage line from cylinder block and the temperature sending unit from cylinder head. Disconnect fuel return line from fuel tank. Disconnect the inlet and pressure line from hydraulic pump, if so equipped. Attach hoist to engine then unbolt and separate engine from clutch housing.

NOTE: When rejoining engine to clutch housing, time can often be saved, particularly on dual clutch models, if the following procedure is used.

Unbolt clutch assembly from flywheel and place same on transmission input shaft. Move sections together until clutch (input) shaft pilot enters pilot bearing and flywheel butts against clutch cover. Now bolt clutch to flywheel and complete the mating of engine and clutch housing by pulling sections together with the retaining cap screws.

Series B-414-354 Non-Diesel

36. To remove the engine and clutch as an assembly, first drain cooling system, remove air cleaner cap and muffler if equipped with vertical exhaust. Then on Series B-414, unlatch and raise hood, remove cotter pins from aft ends of stay rod slides and move hood to a vertical position. Disconnect headlight wires at junction on front support, then remove hood pivot bolts and hood. Do not lose the two hood pivot bolt spacers. On Series 354 remove the hood, radiator grille and air cleaner hose, disconnect the wiring from horn and battery ground cable, then move the harness back on the engine. On either series disconnect drag link, or power steering cylinder if so equipped, from left steering arm. Disconnect upper and lower radiator hoses. Support tractor under clutch housing, then unbolt front support from engine and roll the front support, axle and radiator assembly away from tractor.

On Series B-414, remove battery shield, battery hold-down and battery. Remove battery carrier. On either series, if tractor is equipped with a down swept exhaust, either remove the exhaust pipe from exhaust manifold or disconnect manifold from cylinder head. Disconnect wires from generator, starter switch and ignition coil, unclip wiring loom and lay wires rearward. Disconnect battery cable from starter and operating rod from starter switch. Disconnect choke control from carburetor. Disconnect and remove the governor to bellcrank rod. Close fuel shut-off and disconnect fuel supply line from fuel pump. Disconnect oil pressure line from cylinder block and temperature sending unit from cylinder head. Disconnect inlet and pressure lines from hydraulic pump. Attach hoist to engine, then unbolt and separate engine from clutch housing.

NOTE: When rejoining engine to clutch housing, time can often be saved, particularly on dual clutch models, if the following procedure is used.

Unbolt clutch assembly from flywheel and place same on transmission

input shaft. Move sections together until clutch (input) shaft pilot enters pilot bearing and flywheel butts against clutch cover. Now bolt clutch to flywheel and complete mating of engine and clutch housing by pulling sections together with the retaining cap screws.

Series 424-444-2424-2444 Diesel

37. To remove the engine and clutch as an assembly, first drain the cooling system and disconnect battery cables. Remove the pre-cleaner, muffler (if equipped with vertical exhaust), hood and side panels. On tractors equipped with mechanical steering, unbolt the steering shaft front and rear bearing brackets from the fuel tank support and clutch housing. Slide the steering shafts forward and out of the master splined yoke. On tractors equipped with power steering, remove the steering tube clip from engine and disconnect the tubes from the power steering control valve. Plug and cap all openings to prevent dirt from entering steering system.

Remove the radiator hoses, disconnect headlight wires and unbolt the radiator brace and fan shroud from radiator. Place wood blocks between steering gear housing and axle to prevent tipping. Using a suitable jack under the clutch housing, raise front of tractor to remove most of the weight from the front tires. Unbolt the stay rod bracket from clutch housing and the steering gear housing from front of engine. Raise tractor engine until crankshaft pulley will clear steering gear housing, then roll front end assembly from tractor.

Remove the temperature indicator bulb, fuel shut-off cable and throttle rod. Disconnect wiring harness terminal blocks located under instrument panel and work the harness forward until it is clear of clutch housing. Remove the battery cable from the cranking motor solenoid switch. Disconnect the fuel lines from tank and plug openings. Unbolt the air cleaner bracket from fuel tank support and disconnect the tachometer drive cable. Place a wood block between fuel tank and clutch housing, then disconnect fuel tank support from engine.

Drain hydraulic system and disconnect the hydraulic pump pressure hose from the flow divider valve. Loosen hose clamps and slide the hose coupling forward on the hydraulic pump suction pipe. Plug and cap all openings. Unbolt and remove cranking motor. If tractor is equipped with an underslung muffler, the exhaust pipe can now be removed. Remove clutch housing front dust cover.

Attach a hoist to the engine, unbolt and separate engine from clutch housing.

When rejoining engine to clutch housing, unbolt clutch assembly from flywheel and place same on the pto driving shaft (two stage clutch) and transmission input shaft. Bolt engine to clutch housing, then working through the opening in bottom of clutch housing, bolt clutch assembly to flywheel.

Complete the engine installation by reversing the removal procedure. Vent the fuel system and bleed the power steering system.

Series 424-444-2424-2444 Non-Diesel

38. To remove the engine and clutch as an assembly, first drain the cooling system and disconnect battery cables. If tractor is equipped with vertical exhaust, remove the muffler, then remove the pre-cleaner, hood and side panels. On tractors equipped with mechanical steering, unbolt the steering shaft front and rear bearing brackets from the fuel tank support and clutch housing. Slide the steering shafts forward and out of the master splined yoke. On tractors equipped with power steering, remove the steering tube clip from engine and disconnect the tubes from the power steering control valve. Plug and cap all openings to prevent dirt from entering steering system.

Remove the radiator hoses, temperature indicator bulb, governor control rod and the tank to filter fuel line. Disconnect the headlight wires, choke cable and tachometer drive cable. Unbolt the radiator brace and fan shroud from radiator, then place wood blocks between steering gear housing and axle to prevent tipping. Using a suitable jack under clutch housing, raise front of tractor to remove most of the weight from front tires. Unbolt stay rod bracket from clutch housing and the steering gear housing from front of engine. Raise tractor engine until crankshaft pulley will clear steering gear housing, then roll front end assembly from tractor.

Disconnect wiring harness terminal blocks located under instrument panel and work the harness forward until it is clear of clutch housing. Remove the battery cable from the cranking motor solenoid switch, then unbolt and remove cranking motor. Unbolt the air cleaner bracket from fuel tank support, place a wood block between fuel tank and clutch housing and then unbolt the fuel tank support from engine. If tractor is equipped with an underslung muffler, remove exhaust pipe.

Drain the hydraulic system and disconnect the hydraulic pump pressure hose from the flow divider valve. Loosen hose clamps and slide the hose coupling forward on the hydraulic pump suction pipe. Plug and cap all openings.

Attach a hoist to the engine, unbolt and separate engine from clutch housing.

When rejoining the engine to clutch housing, unbolt clutch assembly from flywheel and place same on the pto driving shaft (two stage clutch) and the transmission input shaft. Bolt engine to clutch housing, then working through the opening in bottom of clutch housing, bolt clutch assembly to flywheel.

Complete the engine installation by reversing the removal procedure. Refill hydraulic reservoir and bleed the power steering system.

CYLINDER HEAD

NOTE: In all engines except Series 424, 444, 2424 and 2444 non-diesel, the cylinder bolt bores in cylinder block are fitted with Heli-Coil inserts which can be removed and renewed using the tools shown in Fig. 27, or their equivalents. New Heli-Coil inserts are installed with the driving lug on bottom and are screwed into the tapped hole until top side of 0.100-0.125 below edge of bore.

Series B-275-B-414-354-364-384 Diesel

39. To remove cylinder head, first drain cooling system and on Series B-275 and B-414, remove air cleaner cap and muffler, if equipped with vertical exhaust. Then, unlatch and raise hood. Remove the radiator brace, then disconnect the hood bracket from tappet cover and place hood in a vertical positon. Remove the hood guide to valve tappet cover brace. Remove battery shield, battery hold-down and batteries. Disconnect fuel return line at tank and at front of hood guide. Dis-

Fig. 27—Tools used to remove and install the Heli-Coil inserts.

1. Extracting tool 2. Inserting tool

connect air cleaner inlet hose from inlet manifold, then unbolt and remove hood guide and air cleaner as a unit. On Series 354, 364 and 384, unbolt and remove hood and disconnect air cleaner inlet hose from inlet manifold. On all series, disconnect wires from alternator or generator and disconnect loom from thermostat housing. Disconnect alternator or generator adjusting strap, remove drive belt, then unbolt and remove mounting bracket and alternator or generator. Disconnect upper hose from radiator, unbolt water outlet elbow and remove outlet and upper hose. Disconnect lead wire from number four glow plug. Remove the temperature indicating sending unit from cylinder head. Remove the breather line which runs from injection pump drive gear cover to intake manifold. On Series B-275 remove lines from fuel filter, disconnect fuel filter bracket from fan shroud and remove bracket and fuel filter. On Series B-414, 354, 364 and 384 disconnect lines from fuel filter but leave filter attached to inlet manifold. On all series, disconnect the pressure lines from injectors, then remove the leak-off (excess) fuel line from the top of each injector. Remove inlet (with fuel filter attached on B-414, 354, 364 and 384 tractors) and exhaust manifolds from cylinder head. Remove tappet lever cover and gasket. Unbolt and remove the tappet levers and shaft assembly.

NOTE: When removing the tappet levers and shaft assembly, keep pressure on outer ends to prevent the two piece shaft assembly from flying apart.

Identify push rods and lift out same, then remove balance of cylinder head bolts and remove cylinder head.

40. Reinstall cylinder head by reversing the removal procedure and when renewing cylinder head gasket, be sure to use the latest type which has ferrules in the two holes shown in Fig. 28. Position cylinder head gasket with word "TOP" upward, use guide studs in the two ferruled gasket holes, then install cylinder head.

Tighten cylinder head bolts in the sequence shown in Fig. 29 and to a torque of 70-75 ft.-lbs. for the B-275, or 75-80 ft.-lbs. for the B-414, 354, 364 or 384 diesel engines. Tighten all manifold stud nuts to 25-30 ft.-lbs. Adjust tappet gap to 0.020 hot on all diesel engines and bleed fuel system as outlined in paragraph 91.

Series B-414-354 Non-Diesel

41. To remove cylinder head, first drain cooling system, and on Series B-414 remove air cleaner cap and muffler, if equipped with vertical exhaust, then unlatch and raise hood. Remove radiator brace, then disconnect the hood bracket from tappet cover and place hood in a vertical position. Remove the hood guide to tappet cover brace. Remove battery shield, battery hold-down and battery. Disconnect air cleaner inlet hose from carburetor, then unbolt and remove hood guide and air cleaner as a unit. On Series 354 unbolt and remove hood, disconnect air cleaner inlet hose from inlet manifold. Then, on both series, disconnect wires from generator and disconnect loom from thermostat housing. Disconnect generator adjusting strap, remove drive belt from generator, then unbolt mounting bracket and remove bracket and generator. Disconnect upper hose from radiator, unbolt water outlet elbow and remove elbow and upper hose. Remove temperature sending unit from cylinder head. Remove manifold and carburetor assembly from cylinder head. Remove tappet lever cover and gasket. Unbolt and remove tappet levers and shaft assembly.

NOTE: When removing the tappet levers and shaft assembly, keep pressure on outer ends to prevent assembly from flying apart.

Identify push rods and lift out same, then remove balance of cylinder head bolts and remove cylinder head.

42. Reinstall cylinder head by reversing removal procedure and when renewing cylinder head gasket, be sure to position cylinder head gasket with word "TOP" upward. Tighten cylinder head bolts to a torque of 75-80 ft.-lbs. in the sequence shown in Fig. 30. Tighten all manifold stud nuts to a torque of 25-30 ft.-lbs. and adjust tappets to 0.020 hot.

Series 424-444-2424-2444 Diesel

43. To remove the cylinder head, first drain cooling system, remove precleaner and muffler, if equipped with vertical exhaust. Remove hood and side panels, then disconnect battery ground cable, generator or alternator wires, oil pressure switch wire, headlight wire and lead wire from number four glow plug. Disconnect generator or alternator adjusting strap, remove drive belt, then unbolt mounting bracket and remove bracket and generator or alternator. Disconnect upper hose from radiator, loosen upper clamp on by-pass hose, then unbolt and remove thermostat housing from cylinder head.

Remove the temperature indicator bulb, the crankcase breather tube and the ground wire from number one glow plug. Disconnect the air cleaner pipe and unbolt and remove the intake manifold. Unbolt and remove the air cleaner and heat shield assembly and after first removing the nuts, lift off the exhaust manifold. Disconnect the pressure lines from injectors and remove the leak-off (excess) fuel line from top of each injector.

CAUTION: Cap or plug openings in injectors and lines immediately.

Unbolt and remove the radiator

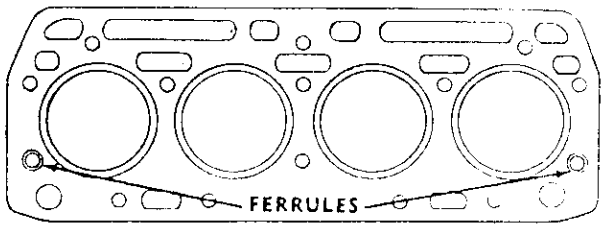


Fig. 28—View showing the two bolt holes fitted with ferrules in the diesel engine cylinder head gaskets.

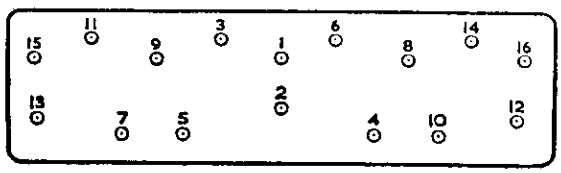


Fig. 29—When reinstalling diesel engine cylinder head, tighten cylinder head bolts in the sequence shown.

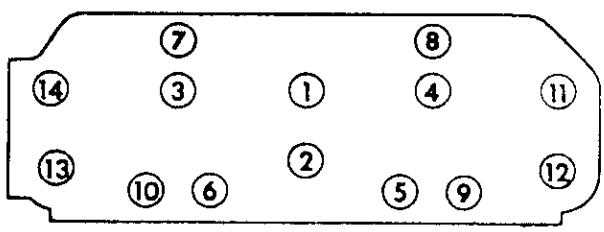


Fig. 30—When reinstalling Series B-414 or 354 non-diesel engine cylinder head, tighten cylinder head bolts in the sequence shown.

brace, rocker arm cover and the rocker arm and shaft assembly.

NOTE: When removing the rocker arm and shaft assembly, keep pressure on outer ends to prevent the two-piece shaft assembly from flying apart.

Lift out push rods, remove balance of cylinder head retaining cap screws and lift off cylinder head.

44. Reinstall cylinder head by reversing the removal procedure and when renewing cylinder head gasket, position gasket with word "TOP" facing upward. Use guide studs in the two ferruled gasket holes, shown in Fig. 28 to align the cylinder head and gasket.

Tighten cylinder head bolts in the sequence shown in Fig. 29 and to a torque of 75-80 ft.-lbs. Tighten all manifold stud nuts to a torque of 25-30 ft.-lbs. Adjust tappet gap to 0.020 hot on both intake and exhaust valves. Bleed fuel system as outlined in paragraph 91.

Series 424-444-2424-2444 Non-Diesel

45. To remove the cylinder head, first drain cooling system, remove precleaner and muffler, if equipped with vertical exhaust. Remove hood and side panels, then disconnect battery ground cable, oil pressure switch wire and ignition wires from coil and resistor. Unclip wiring harness and lay it along left side of engine. Remove upper radiator hose, radiator brace, temperature indicator bulb and loosen upper hose clamp on thermostat by-pass hose. Unbolt and remove air cleaner and pipe assembly. Disconnect choke cable, governor rod and fuel line from carburetor. Then, unbolt and remove the manifold and carburetor assembly. Disconnect spark plug wires and remove the governor control rod clip from right side of cylinder head. Unbolt and remove the rocker arm cover and rocker arms and shaft assembly. Lift out push rods, remove cylinder head retaining cap screws and lift off cylinder head.

46. Reinstall cylinder head by reversing the removal procedure. When renewing cylinder head gasket, apply a light coating of lubricant to top face of cylinder block. The head gasket is marked for correct installation.

Tighten cylinder head bolts in the sequence shown in Fig. 31 and to a torque of 80-90 ft.-lbs. Tighten manifold stud nuts to a torque of 33-37 ft.-lbs. Adjust tappet gap to 0.014 hot for the intake valves and 0.020 hot for exhaust valves.

VALVES AND SEATS

All Models

47. Intake and exhaust valves are not interchangeable and on all series except 424, 444, 2424 and 2444 non-diesels, seat directly in the cylinder head. Series 424, 444, 2424 and 2444 non-diesel exhaust valves seat on renewable inserts which are available in standard size as well as oversizes of 0.015 and 0.030. Valves have a face and seat angle of 45 degrees. Seat width should be 0.070-0.080 and total runout must not exceed 0.002. Adjust valve tappet gap on all models except 424, 444, 2424 and 2444 non-diesels to 0.020 (hot) for both intake and exhaust valves. On Series 424, 444, 2424 and 2444 non-diesels, adjust valve tappet gap to 0.014 (hot) for intake valves and 0.020 (hot) for exhaust valves.

Use the chart shown in Fig. 32 for valve tappet gap adjusting procedure. Four valves are adjusted when No. 1 piston is at TDC (compression) and the remaining four are adjusted when No. 4 piston is at TDC (compression).

Stem diameter of valves used in Series 424, 444, 2424 and 2444 non-diesel engines is 0.3405-0.3415 and normal operating clearance in guides is 0.0015-0.0035. Valve stem diameter on all other series is 0.341-0.342 and normal operating clearance in guides is 0.002-0.004.

When removing exhaust valve seat inserts from a Series 424, 444, 2424 or 2444 non-diesel cylinder head, use the proper puller. Do not attempt to drive a chisel under seat insert as counterbore will be damaged. Chill new seat insert with dry ice or liquid Freon and when insert is properly bottomed, it should be 0.008 to 0.030 below edge of counterbore. After installation, peen the cylinder head material around the complete outer circumference of the valve seat insert.

VALVE GUIDES AND SPRINGS

All Models

48. The shouldered valve guides used in diesel engines are not interchangeable. The inside diameter of all guides is 0.344-0.345 which provides a normal operating clearance of 0.002-0.004 for the valves. Press out old guides from bottom of cylinder head. Press new guides in top of cylinder head until shoulder of guide bottoms against cylinder head. When correctly installed, guide will protrude 0.938 from top of cylinder head. Guides are pre-sized; however, they should be reamed after installation, if necessary, to obtain the 0.344-0.345 inside diameter.

49. The shouldered valve guides used in B-414 and 354 series non-diesel engines are not interchangeable and can be pressed out from bottom of cylinder head. Press new guides in top of cylinder head until shoulder of guide bottoms against cylinder head. When correctly installed, top of intake guide is 0.828 inch; and top of exhaust guide is 0.984 inch, above spring recess of cylinder head. Guides are pre-sized; however, they should be reamed after installation, if necessary, to obtain an inside diameter of 0.344-0.345.

50. The valve guides used in Series 424, 444, 2424 and 2444 non-diesel

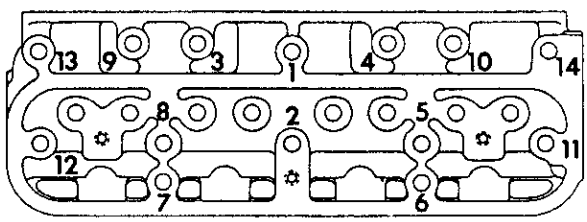
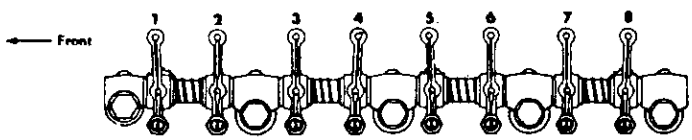


Fig. 31—When installing Series 424, 444, 2424 and 2444 non-diesel cylinder head, tighten cylinder head bolts in the sequence shown.

WITH	ADJUST VALVES (Engine Warm)							
No. 1 Piston at T.D.C. (Compression)	1	2	3		5			
No. 4 Piston at T.D.C. (Compression)				4		6	7	8



Numbering sequence of the valves which correspond to the chart.

Fig. 32—Chart shows the valve tappet gap adjusting procedure.

engines are interchangeable. Valve guides are not shouldered and should be pressed in cylinder head until top of guides are 13/16-inch above surface of cylinder head. Inside diameter of valve guides are pre-sized to 0.343-0.344 and if not distorted during installation, will require no final sizing.

51. On B-275 series diesel engines, intake and exhaust valve springs are interchangeable. Renew springs which are rusted, discolored or do not meet the following specifications:

Free length ..... 2.531 inches
Test load ..... 42.5 lbs. at 1.703 inches

On Series 424, 444, 2424, 2444, B-414, 364 and 384 diesel engines, each valve is fitted with two valve springs. Renew springs which are rusted, discolored or do not meet the following specifications:

Inner spring,
Free length ..... 2.125 inches
Test load ..... 12.4-13.7 lbs. at 1.653 inches
Outer spring,
Free length ..... 2.550 inches
Test load ..... 29.5-32.6 lbs. at 1.870 inches

On Series 354 diesel engine intake and exhaust valve springs are interchangeable. Renew springs which are rusted, discolored or do not meet the following specifications:

Free length ..... 2.48-2.58 inches
Test load ..... 28.7-31.7 lbs. at 1.922 inches

On B-414 and 354 series non-diesel engines, intake and exhaust valve springs are interchangeable. Renew springs which are rusted, discolored or do not meet the following specifications:

Free length ..... 2.085 inches
Test load ..... 71.6-84.0 lbs. at 1.346 inches

On Series 424, 444, 2424 and 2444 non-diesel engines, exhaust valves are equipped with positive type valve rotators ("Rotocaps"). Therefore, exhaust and intake valve springs are not interchangeable. Renew springs which are rusted, discolored or do not meet the following specifications:

Intake valve spring,
Free length ..... 2.734 inches
Test load ..... 49-54.6 lbs. at 1.683 inches
Exhaust valve spring (with rotocap),
Free length ..... 2.240 inches
Test load ..... 80.1-87.1 lbs. at 1.456 inches

VALVE TAPPETS (CAM FOLLOWERS)

All Models

52. The mushroom type tappets operate directly in the unbushed crankcase bores and can be removed after removing the camshaft as outlined in paragraph 66 and 67. Normal operating clearance of tappets in crankcase bores is 0.0005-0.003.

VALVE TAPPET LEVERS (ROCKER ARMS)

All Models

53. The valve levers and lever shaft assembly are lubricated via drilled passages in cylinder block and cylinder head. Replacement levers with bushings are available for all engines and bushings are available separately for all levers except those used in Series 424, 444, 2424 and 2444 non-diesel engines.

Procedure for removal of the valve levers assembly is evident after removing the tappet lever cover.

NOTE: When removing the tappet levers and shaft assembly from all engines, except Series 424, 444, 2424 and 2444 non-diesel engines, keep pressure on outer ends to prevent the two-piece shaft assembly from flying apart.

When renewing bushings in valve levers (all engines except Series 424, 444, 2424 and 2444 non-diesel), be sure oil hole in bushing aligns with oil hole in valve lever and ream bushings after installation to an inside diameter of 0.751-0.752.

On all models, the end of the valve lever which contacts the valve can be refinished, if necessary, providing the original contour is carefully maintained. Check the valve levers and valve lever shafts against the values which follow:

Valve lever bore 0.751-0.752
Lever shaft diameter 0.748-0.749
Lever diametral clearance 0.002-0.004

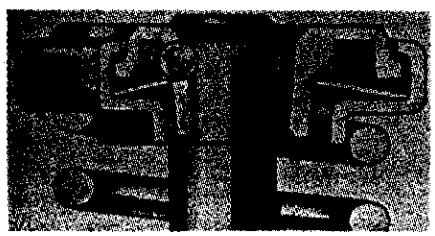


Fig. 33—Cut-away view showing typical installation of a valve rotator.

VALVE ROTATORS

Series 424-444-2424-2444-354 Non-Diesel

54. Positive type valve rotators ("Rotocaps") are factory installed on the exhaust valves in these engines.

Normal servicing of the valve rotators consists of renewing the units. It is important, however, to observe the valve action after the engine is started. Rotator action can be considered satisfactory if the valve rotates a slight amount each time the valve opens. A cut-away view of a typical "Rotocap" installation is shown in Fig. 33.

VALVE TIMING

All Models

55. Valves are properly timed when the single punch marked tooth on the camshaft gear is meshed with the single punch marked tooth space on crankshaft gear as shown in Fig. 34, 36 and 40.

TIMING GEAR COVER

Series B-275-B-414-354-364-384 Diesel

56. To remove the timing gear cover, first remove the front support, axle and radiator assembly as follows: Drain cooling system, then on Series B-275

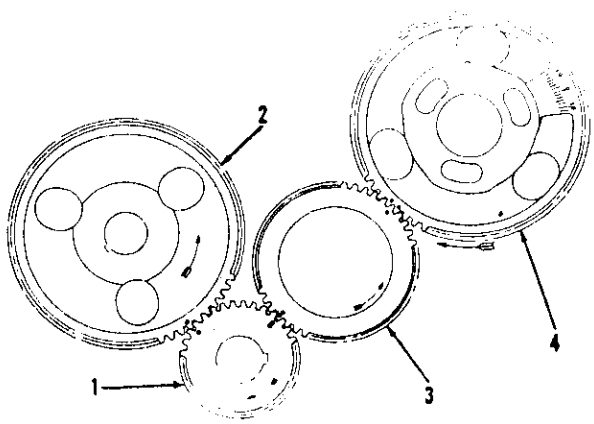


Fig. 34—View showing timing marks on timing gear train of early B-275 tractor equipped with injection pump having pneumatic governor. Refer also to Fig. 35.

1. Crankshaft gear
2. Camshaft gear
3. Idler gear
4. Injection pump gear

and B-414, raise hood and disconnect headlight and horn wires at junction on front support, then unclip loom from radiator. Remove cotter pins from ends of stay rod slides, remove hood pivot bolts and remove hood. Do not lose the pivot bolt spacers. Disconnect radiator brace and on Series B-275, disconnect the fuel filter bracket from radiator. On Series 354, 364 and 384, remove hood and radiator grille. Disconnect ground lead, horn wire and move the harness back to the engine, then disconnect air cleaner hose. On all models, disconnect upper and lower hoses from radiator. Disconnect the drag link or power steering cylinder, if so equipped, from left steering arm. Support tractor, attach hoist to the front support, axle and radiator assembly, then unbolt front support and move assembly away from tractor.

Remove alternator or generator adjusting strap, then remove belt from alternator or generator and let belt hang on water pump. Loosen water pump pulley flange or the belt adjusting pulley on models so equipped, and remove water pump belt from crankshaft pulley. Unbolt and remove water pump. Remove the breather line which runs from injection pump gear cover to inlet manifold, then unbolt and remove injection pump gear cover.

NOTE: Notice the size and location of the cap screws as they are removed.

Remove crank nut, crankshaft pulley, woodruff key and two front oil pan cap screws. Unbolt and remove front cover as shown in Fig. 35.

When installing new oil seal in timing gear cover, install same with lip facing inward.

Series B-414-354 Non-Diesel

57. To remove the timing gear cover, first remove the front support, axle and radiator assembly as follows: Drain cooling system, then on Series B-414, raise hood and disconnect headlight wires and horn wire (if so equipped) at junction on front support, then unclip wiring loom. Remove cotter pins from ends of stay rod slides, remove hood pivot bolts and remove hood. Do not lose the pivot bolt spacers. Disconnect upper radiator brace. On Series 354, remove hood and radiator grille. Disconnect ground lead, horn wire and move the harness back to the engine, then disconnect air cleaner hose. On both series, disconnect upper and lower radiator hoses from radiator. Disconnect drag link, or power steering cylinder if so equipped, from left steering arm. Support tractor, attach hoist to front support, axle and radiator assembly, then unbolt front support and move assembly away from tractor.

Remove fan blades, loosen water pump pulley adjusting flange and remove water pump drive belt. Unclip wiring loom from water pump. Remove crankshaft pulley and the two front oil pan bolts. Unbolt and remove timing gear cover.

NOTE: Identify cap screws as they are removed. Refer to Fig. 36.

When installing new oil seal in timing gear cover, install same with lip facing inward.

Series 424-444-2424-2444 Diesel

58. To remove the timing gear cover, first remove the front support, axle and radiator assembly as follows: Drain cooling system, remove hood and disconnect radiator hoses. Disconnect the headlight wires and unbolt the radiator brace and fan shroud from radiator. On tractors equipped with mechanical steering, drive roll pin from forward yoke of front steering shaft universal and remove cap screws from front steering shaft support. Drive front universal from steering worm shaft. If tractor is equipped with hydrostatic steering, disconnect the steering cylinder hoses, then cap and plug all openings to prevent dirt from entering system.

Then, on all tractors, place wood blocks between steering gear housing and axle to prevent tipping. Using a suitable jack, support tractor under clutch housing. Unbolt stayrod bracket from clutch housing and steering gear housing from front of engine. Raise engine until crankshaft pulley will clear steering gear housing, then roll assembly from tractor.

Remove generator or alternator adjusting strap, then remove drive belt from pulley and let belt hang on water pump. Loosen water pump belt adjusting pulley and remove water pump belt from crankshaft pulley. Unbolt and remove water pump. Remove the breather line which runs from injection pump gear cover to intake manifold, then unbolt and remove injection pump gear cover. Remove crankshaft pulley nut, pulley and Woodruff key. Unbolt and remove timing gear cover.

When installing new oil seal in tim-

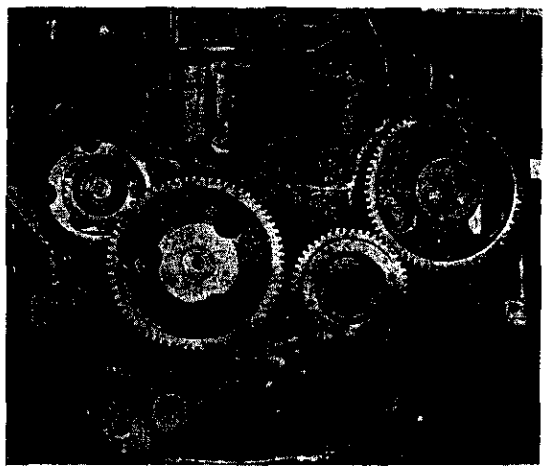


Fig. 35—View showing timing gear train of late B-275 and all B-414, 424, 444, 2424, 2444, 354, 364 and 384 tractors equipped with injection pump having mechanical governor. Timing marks are similar to those shown in Fig. 34.

1. Crankshaft gear
2. Camshaft gear
3. Idler gear
4. Injection pump gear
5. Hydraulic pump gear

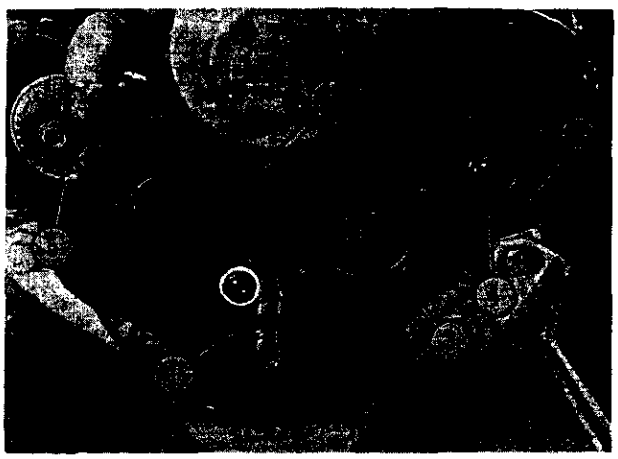


Fig. 36—View of B-414 and 354 non-diesel engine gear train. Note timing marks on gears (1) and (2).

S. Governor housing screws
1. Crankshaft gear
2. Camshaft gear
3. Idler gear
4. Governor gear
5. Hydraulic pump gear

ing gear cover, install same with lip facing inward.

Series 424-444-2424-2444 Non-Diesel

59. To remove the timing gear cover, first remove the front support, axle and radiator assembly as follows: Drain cooling system, remove hood and disconnect radiator hoses. Disconnect the headlight wires and unbolt the radiator brace and fan shroud from radiator. On tractors equipped with mechanical steering, drive roll pin from forward yoke of front steering shaft universal and remove cap screws from front steering shaft support. Drive front universal from steering worm shaft.

If tractor is equipped with hydrostatic steering, disconnect the steering cylinder hoses, then cap and plug all openings to prevent dirt from entering system.

Then, on all tractors, place wood blocks between steering gear housing and axle to prevent tipping. Support tractor under clutch housing with a suitable jack. Unbolt stay rod bracket from clutch housing and steering gear housing from front of engine. Raise engine until crankshaft pulley will clear steering gear housing, then roll assembly from tractor.

Remove generator or alternator adjusting strap, then remove the drive belt. Unbolt and remove water pump and governor housing. After first removing the crank nut, attach a suitable puller and remove crankshaft pulley and Woodruff key. Unbolt and remove the timing gear cover from engine.

Extra care must be taken when installing the oil seal in timing gear cover, so as not to distort or bend the cover. Install seal with lip of same facing inward toward timing gears.

NOTE: A wear ring is furnished with the new oil seal. Ring must be pressed on sealing surface of crankshaft pulley.

When reassembling, leave the cover retaining cap screws loose until crankshaft pulley has been installed. This will facilitate centering the seal with respect to the pulley.

TIMING GEARS

All Series Except 424-444-2424-2444 Non-Diesel

60. **CAMSHAFT GEAR.** To remove the camshaft gear, first remove timing gear cover as outlined in paragraphs 56, 57 or 58. Remove tappet cover, valve levers and shaft assembly and push rods. Drain and remove oil pan, then unbolt and remove oil pump. Check camshaft end play which should be 0.008-0.017. If end play is excessive, renew thrust plate after camshaft gear is removed. Turn camshaft until holes in gear align with thrust plate cap screws, then remove the cap screws. Carefully pull camshaft from cylinder block and catch each tappet as the camshaft is removed. Press camshaft out of gear and remove Woodruff key and thrust plate.

When installing camshaft gear, press same on camshaft until it bottoms against shoulder on camshaft. Install camshaft and align timing marks as shown in Fig. 34 or 36.

61. **CRANKSHAFT GEAR.** To remove the crankshaft gear, first remove timing gear cover as outlined in paragraphs 56, 57 or 58. The crankshaft gear has two tapped holes to provide for removal and can be removed at this time by using a suitable puller.

When reinstalling crankshaft gear, align timing marks as shown in Fig. 34 or 36.

62. **IDLER GEAR.** The idler gear (3—Fig. 34 or 36) can be removed after the timing gear cover has been removed as outlined in paragraphs 56, 57 or 58. Refer to Fig. 37 for a view of the removed gear and shaft. Prior to installing gear and shaft, inspect the Heli-Coil insert and renew if necessary.

On diesel engines, align timing marks on all gears as shown in Fig. 34 when installing idler gear. When installing idler gear shaft, be sure dowel pin (P—Fig. 37) in shaft enters hole (H—Fig. 38) in cylinder block. Tighten the retaining cap screw to a torque of 75 ft.-lbs. Operating clearance of gear on shaft is 0.0015-0.0028. If clearance is excessive, renew gear and/or shaft.

63. **INJECTION PUMP GEAR.** Refer to Fig. 35 or 39 for views of the two types of injection pump drive gears

Fig. 37—Removed idler gear and shaft. Pin (P) enters oil hole in cylinder block shown in Fig. 38. Diesel engine gear is shown, however, B-414 and 354 non-diesel gear is similar.

Fig. 38—Hole (H) accepts the pin which is on rear side of idler gear shaft. Refer to Fig. 37.

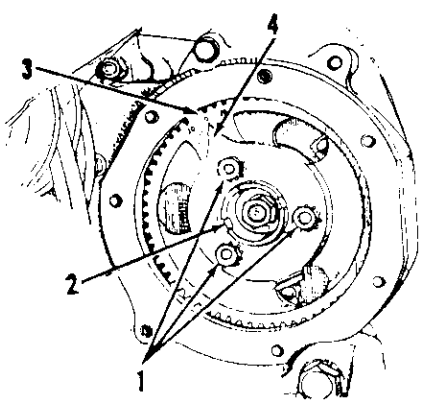


Fig. 39—Injection pump drive gear used on early B-275 tractors equipped with injection pump having pneumatic governor.

1. Cap screws
2. Hub groove
3. Pump gear
4. Timing pointer

that have been used. In both cases, it will be necessary to remove the timing gear cover as outlined in paragraphs 56 and 58 before gear can be removed.

When reinstalling the gear and timing pointer shown in Fig. 39, refer to paragraph 103 for injection pump timing procedure.

Series 424-444-2424-2444 Non-Diesel

64. **CAMSHAFT GEAR.** To remove the camshaft gear, first remove timing gear cover as outlined in paragraph 59. Remove the valve cover, valve levers and shaft assembly, push rods, oil pan and oil pump. Push tappets up into their bores. Check camshaft end play which should be 0.003-0.012. If end play is excessive, renew thrust plate after camshaft gear is removed. Working through openings in camshaft gear, remove the cap screws retaining the shaft thrust plate to crankcase. Carefully withdraw camshaft and gear assembly and catch each tappet as shaft is removed. Gear can now be removed from camshaft by using a suitable press.

When reassembling, mesh the single punch marked tooth on camshaft gear with single punch marked tooth space on crankshaft gear and the double punch marked tooth on camshaft gear with the double punch marked tooth space on the governor and ignition unit drive gear. Refer to Fig. 40.

65. **CRANKSHAFT GEAR.** To remove the crankshaft gear, first remove engine from tractor as outlined in paragraph 38. Then, remove oil pan, oil pump, timing gear cover, clutch, flywheel and rear oil seal assembly. Remove connecting rod caps and main bearing caps and lift crankshaft from cylinder block. The gear can now be removed from crankshaft by using a suitable press.

When reinstalling crankshaft in cylinder block, align timing marks as shown in Fig. 40.

CAMSHAFT

All Series Except 424-444-2424-2444 Non-Diesel

66. If the camshaft only is to be removed, same can be done without removing engine from tractor and the procedure for doing so is given in paragraph 60. However, if service is required on the camshaft bushings and/or expansion plug (4—Fig. 41) located at the rear of camshaft, remove the engine as outlined in paragraphs 35, 36 or 37.

With the engine removed, remove camshaft as outlined in paragraph 60. Then, unbolt clutch from flywheel and flywheel from crankshaft. Bump out expansion plug.

NOTE: Camshaft bushings are furnished semi-finished for service and must be align reamed after installation.

When installing the bushings, be sure oil holes in same align with oil holes in cylinder block. Install the front and rear bushings with the "FRONT" marking toward front of engine and be sure front of rear bushing is flush with the front of its bore in order to allow room for the expansion plug installation.

Specifications for the camshaft and camshaft bushings are as follows:

Camshaft Journal Diameter,	
Front	1.811-1.812
Center	1.577-1.578
Rear	1.499-1.500
Camshaft Bushing (Reamed I.D.),	
Front	1.8135-1.8145
Center	1.5795-1.5805
Rear	1.5015-1.5025
Camshaft End Play	0.008-0.017
Gear Backlash	0.0025-0.0045
Journal Operating Clearance	0.0015-0.0035

When installing the rear expansion plug, use sealing compound on plug and seat. Install camshaft and gear with the

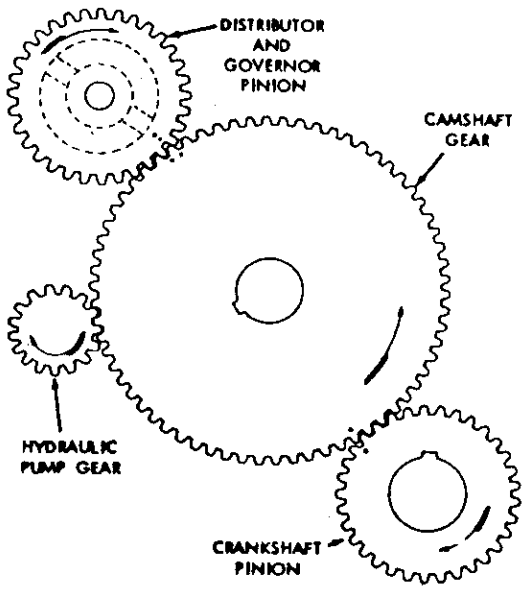


Fig. 40—View showing timing marks on timing gear train of Series 424, 444, 2424 and 2444 non-diesel engine.

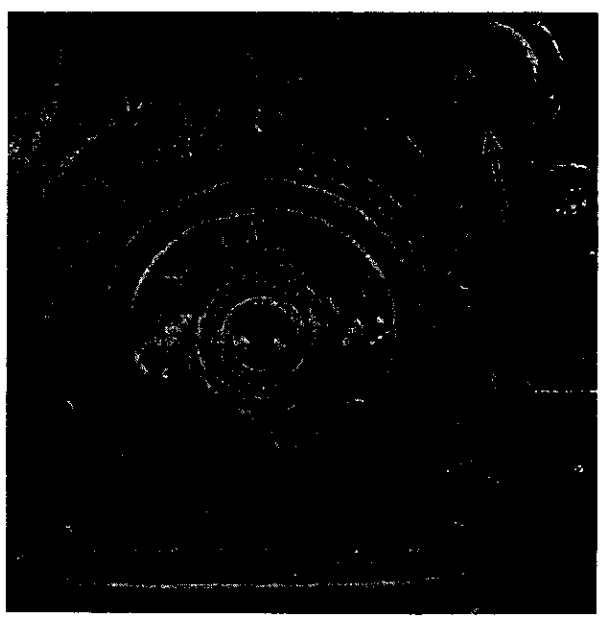


Fig. 41—Crankshaft rear oil seal and retainer installed. Note camshaft expansion plug.

1. Crankshaft
2. Oil seal
3. Retainer
4. Expansion plug

timing marks aligned as shown in Fig. 34 or 36.

Series 424-444-2424-2444 Non-Diesel

67. If camshaft only is to be removed, same can be done without removing engine from tractor and the procedure for doing so is given in paragraph 64. The camshaft front journal rides in a renewable bushing while the intermediate and rear camshaft journals ride directly in the crankcase bores. The bushing can be renewed after removing the camshaft.

However, if the expansion plug (4—Fig. 41) located at rear of camshaft is to be renewed, remove engine as outlined in paragraph 38.

With engine removed, remove camshaft as outlined in paragraph 64. Then, unbolt and remove the clutch, flywheel and engine rear support plate. Bump out expansion plug.

When installing the rear expansion plug, use sealing compound on plug and seat.

The camshaft front bushing is presized and when correctly installed, no final sizing is required. When installing the bushing, make certain that oil holes in bushing align with oil holes in cylinder block.

Specifications for the camshaft are as follows:

Camshaft Journal Diameter,	
Front	1.811-1.812
Center	1.577-1.578
Rear	1.499-1.500
Camshaft End Play	0.003-0.012
Journal Operating Clearance	0.0009-0.0054

Install camshaft and gear with timing marks aligned as shown in Fig. 40.

ROD AND PISTON UNITS

All Models

68. Connecting rod and piston units are removed from above after cylinder head, oil pan and oil pump have been removed. Cylinder numbers are marked on rods and caps. When reassembling, make certain that numbers are in register and on all except Series 424, 444, 2424 and 2444 non-diesel engines, numbers are on the side opposite camshaft. On Series 424, 444, 2424 and 2444 non-diesel engines, rod and cap numbers are on camshaft side of engine. Torque rod bolts to 30-35 ft.-lbs. on Series B-275 and secure with lock wire. Rod bolts on all Series B-414, 354, 364 and 384 are self-locking and should be torqued to 40-45 ft.-lbs. Series 424, 444, 2424 and 2444 non-diesel rod bolts are self-locking and should be tightened to a torque of 43-49 ft.-lbs. Tighten the self-locking rod bolts used in Series 424, 444, 2424 and 2444 diesel engines to a torque of 40-45 ft.-lbs.

PISTONS, SLEEVES AND RINGS

All Series Except 424-444-2424-2444 Non-Diesel

69. Pistons and sleeves are available as individual parts or as a matched set. Recommended clearance of new pistons in new sleeves is 0.0048-0.0056 for B-275 diesel engines, or 0.0031-0.0039 for 364, 384, 424, 2424 and 2444 diesel engines and Series B-414 and 354 diesel and non-diesel engines, when measured between piston skirt and cylinder sleeve at 90 degrees to piston pin.

NOTE: As individual replacements, fit pistons to a clearance of 0.0031-0.0047.

70. The wet type cylinder sleeves should be renewed when out-of-round exceeds 0.008 and/or taper exceeds 0.005.

Special pullers are available to remove the wet type sleeves from above after the pistons have been removed. Before installing sleeves, check to make certain that the counterbore at top and sealing ring groove at the bottom are clean and free from foreign material. All sleeves should enter crankcase bores full depth and should be free to rotate by hand when tried in bores without sealing rings. After making trial installation without sealing rings, remove the sleeves, wet new sealing rings and end of sleeves with a thick soap solution or equivalent and install sleeves. If sealing ring is in place and not pinched, very little hand pressure is required to press the sleeve completely into place. Normally, the top of the sleeves will extend 0.003-0.007 above the machined top surface of the cylinder block. If sleeve stand out is excessive, check for foreign material under the sleeve flange.

NOTE: The cylinder head gasket forms the upper cylinder sleeve seal, and excessive sleeve stand out will result in coolant leakage.

To test lower sealing rings for proper installation, fill crankcase (cylinder block) water jacket with cold water and check for leaks near bottom of sleeves.

71. Diesel engine pistons are fitted with five rings; three compression and two oil control rings. Gasoline engine pistons are fitted with four rings; three compression and one oil control ring.

Specifications are as follows:

Ring Width (B-275 Diesel)	
Compression rings	0.0930-0.0935
Top oil control	0.1875
2nd oil control	0.1860-0.1865
Ring Width (B-414-424-444-2424-2444-354-364-384 Diesel)	
Compression rings	0.0927 0.0937
Top oil control	0.1865-0.1875
2nd oil control	0.1865-0.1875
Ring Width (B-414-354 Non-Diesel)	
Compression rings	0.0930-0.0935
Oil control	0.1860-0.1865
Ring End Gap (B-275 Diesel)	
Compression rings	0.012-0.018
Top oil control	0.015-0.045
2nd oil control	0.012 0.018
Ring End Gap (B-414-424-444-2424-2444-354-364-384 Diesel)	
Compression rings	0.010-0.015
Top oil control	0.010-0.015
2nd oil control	0.010-0.015
Ring End Gap (B-414-354 Non-Diesel)	
Compression rings	0.012-0.018
Oil control	0.012-0.018
Ring Side Clearance (B-275 Diesel)	
Top compression	0.0028-0.0039
2nd compression	0.0032-0.0043
3rd compression	0.0024-0.0035
Top oil control	0.0015-0.0045
2nd oil control	0.0012-0.0023
Ring Side Clearance (B-414-424-444-2424-2444-354-364-384 Diesel)	
Top compression	0.0035-0.0055
Other compression	0.0028-0.0048
Top oil control	0.0012-0.0028
2nd oil control	0.0012-0.0028
Ring Side Clearance (B-414-354 Non-Diesel)	
Compression rings	0.0018-0.0033
Oil control	0.0025-0.0040

When installing piston rings, be sure that the largest diameter of the stepped top compression ring is on bottom side. Position rings so that end gaps are 90 degrees from thrust side of piston and are 180 degrees from one another.

PISTONS AND RINGS

Series 424-444-2424-2444 Non-Diesel

72. The cam ground aluminum alloy pistons operate directly in the block bores and are available in standard size as well as oversizes of 0.010, 0.020, 0.030 and 0.040. With pistons removed from engine, measure cylinder bores both parallel and at right angle to the crankshaft centerline. If taper from top of cylinder to bottom of piston travel exceeds 0.006, or if out-of-round more than 0.006, rebore cylinder to next larger size.

NOTE: When reboring, bore cylinder to within approximately 0.001 of desired

size to allow finish honing.

To fit pistons in bores, attach a 0.001 ribbon gage (½-inch wide) to a spring scale, then invert piston and position feeler ribbon at 90 degrees from the piston pin hole. Insert piston and feeler ribbon into cylinder bore until piston is about 3 inches below top of cylinder block. Keep piston pin hole parallel with crankshaft. Now withdraw the feeler ribbon by pulling straight up on the spring scale and note reading on scale as feeler ribbon is being withdrawn. Pistons are correctly fitted to the normal 0.001-0.002 clearance when the spring scale pull reads 2-6 lbs.

73. Pistons are fitted with two compression rings and one oil control ring. The two compression rings have an end gap of 0.010-0.020 and the oil control ring end gap should be 0.018-0.028. Side clearance of rings in piston grooves is 0.003-0.0045 for the top compression ring, 0.0015-0.003 for the second compression ring and 0.002-0.0035 for the oil control ring.

Piston rings are available in standard size as well as oversizes of 0.010, 0.020, 0.030 and 0.040.

PISTON PINS

All Models

74. Piston pins are retained in piston bosses by snap rings and are available in standard size and 0.005 oversize. The 0.005 oversize pin is identified by a plus 5 marking on one end.

75. On Series 424, 444, 2424 and 2444 non-diesel engines standard piston pin diameter is 0.8591-0.8593. Piston pin should have a diametral clearance of 0.0002 in piston bosses and 0.0004 in connecting rod bushing. Maximum allowable clearance of pin in piston is 0.0025 and in rod is 0.003. Total clearance between end of piston pin and snap ring is 0.005-0.055.

76. On all other series engines, standard piston pin diameter is 1.1021-1.1024 and should have a diametral clearance of 0.0005-0.0008 in the connecting rod bushing and be a hard hand push fit in the piston at a room temperature of 68 degrees F. Fit the oversize pins in the same manner. Total clearance between end of piston pin and snap ring is 0.012-0.020.

CONNECTING RODS AND BEARINGS

All Series Except 424-444-2424-2444 Non-Diesel

77. Connecting rod bearings are of the slip-in, precision type, renewable from below after removing the oil pan and connecting rod bearing caps. When installing new inserts, make certain that the projections on same engage slots in connecting rod and cap and that the cylinder identifying numbers on rod and cap are in register and face opposite camshaft side of engine. Connecting rod bearings are available in standard size as well as undersizes of 0.015 and 0.030. Bearing inserts should have a running clearance of 0.001-0.0029 on the 1.7495-1.750 diameter crankshaft crankpins. Rod side play is 0.003-0.010.

Piston pin bushing is furnished semi-finished and must be reamed after installation to provide 0.0005-0.0008 clearance for the piston pin. Be sure oil holes in bushing and connecting rod align after bushing is installed.

Torque the connecting rod bolts to 30-35 ft.-lbs. for Series B-275 and secure with lockwire. Rod bolts, for all Series B-414, 354, 364 and 384 engines and Series 424, 444, 2424 and 2444 diesels, are self-locking and should be torqued to 40-45 ft.-lbs.

Series 424-444-2424-2444 Non-Diesel

78. Connecting rod bearings are of the slip-in, precision type, renewable from below after removing the oil pan and connecting rod bearing caps. When installing new inserts, make certain that the projections on same engage slots in connecting rod and cap and that cylinder identifying numbers on rod and cap are in register and face the camshaft side of engine. Connecting rod bearings are available in standard size as well as undersizes of 0.002, 0.010, 0.020 and 0.030. Bearing inserts should have a running clearance of 0.0009-0.0039 on the 2.059-2.060 standard diameter crankshaft crankpins. Rod side play should be 0.005-0.014.

Piston pin bushing is furnished semi-finished and must be reamed after installation to provide 0.0004 clearance for piston pin. Be sure oil holes in bushing and connecting rod align after bushing is installed.

Tighten the self-locking rod bolts evenly to a torque of 43-49 ft.-lbs.

CRANKSHAFT AND MAIN BEARINGS

All Series Except 424-444-2424-2444 Non-Diesel

79. The crankshaft is supported in five slip-in, precision type main bearings, renewable from below after removing the oil pan, oil pump and main bearing caps. Normal crankshaft end play of 0.004-0.008 is controlled by the flanged rear main bearing inserts. Excessive crankshaft end play is corrected by renewing the inserts. Main bearings are available in standard size as well as undersizes of 0.015 and 0.030.

Crankshaft removal requires removal of engine from tractor as outlined in paragraphs 35, 36 or 37, then remove oil pan, oil pump, timing gear cover, clutch, flywheel and rear oil seal. Remove connecting rod caps and main bearing caps and lift crankshaft from cylinder block.

NOTE: Check main bearing caps and if they are not identified, do so before removing.

Check the crankshaft and bearings against the values which follow:

Crankpin diameter	1.7495-1.750
Rod bearing clearance	0.001-0.0029
Main journal diameter	2.124-2.125
Main bearing clearance	0.002-0.004
Crankshaft end play	0.004-0.008
Journal max. allowable taper (per inch)	0.0015
Journal max. out-of-round	0.005
Crankshaft max. run-out (center main)	0.0008

Connecting rod and main bearing bolt torque values are as follows: Series B-275 rod bolts, 30-35 ft.-lbs.; main bearing bolts, 70-75 ft.-lbs. All Series B-414, 354, 364 and 384 and Series 424, 444, 2424 and 2444 diesel rod bolts, 40-45 ft.-lbs.; main bearing bolt torque is as follows:

Pitch bolt	70-75 ft.-lbs.
Place bolt	80-85 ft.-lbs.

NOTE: Refer to paragraph 80 for bolt identification.

80. On some series of engines, two types of main bearings bolts are used. The PITCH bolt has a standard bolt head with a washer face. The thread diameter is larger than the shank. This type attains its tension by stretching of the shank and should be torqued to 70-75 ft.-lbs. The PLACE bolt has a head that is either notched or concave and the shank and thread diameter are nearly the same. This type attains its tension by bending the bolt head and should be torqued to 80-85 ft.-lbs.

Series 424-444-2424-2444 Non-Diesel

81. The crankshaft is supported in three slip-in, precision type main bearings, renewable from below after removing the oil pan, rear oil seal retainer plate and main bearing caps. Normal crankshaft end play of 0.004-0.010 is controlled by the flanged rear main bearing inserts. Excessive end play is corrected by renewing the inserts. Main bearings are available in standard size as well as undersizes of

0.002, 0.010, 0.020 and 0.030.

Crankshaft removal requires removal of engine from tractor as outlined in paragraph 38. Then, remove the oil pan, oil pump, timing gear cover, clutch, flywheel, engine rear support plate and rear oil seal. Remove connecting rod caps and main bearing caps and lift crankshaft from cylinder block.

Check the crankshaft and bearings against the values which follow:

Crankpin diameter	2.059-2.060
Rod bearing clearance	0.0009-0.0039
Main journal diameter	2.6235-2.6245
Main bearing clearance	0.009-0.0039
Journal max. allowable taper	0.003
Journal max. out-of-round	0.003
Crankshaft end play	0.004-0.010

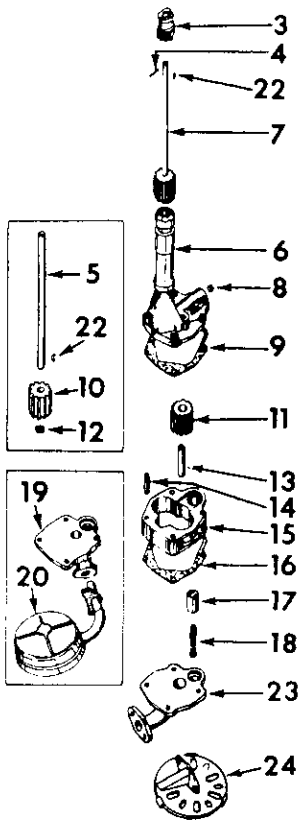


Fig. 42—Exploded view of typical oil pump used on all series except 424, 444, 2424 and 2444 non-diesel engines. Items 5, 10, 12, 19, 20 and 22 are used on early type pump. NOTE: On early B-275 oil pump, a ball was used in place of plunger (17) to regulate oil pressure. Diesel and non-diesel pumps are basically similar.

3. Pinion
4. Roll pin
5. Shaft
6. Body
7. Shaft assy.
8. Plug
9. Gasket
10. Gear
11. Gear
12. Retainer
13. Idler shaft
14. Roll pin
15. Gearcase
16. Gasket
17. Pressure regulator valve
18. Pressure regulator spring
19. Pump cover
20. Screen assy.
22. Woodruff key
23. Pump cover
24. Screen assy.

Connecting rod bolts and main bearing bolts should be tightened evenly to a torque of 43-49 ft.-lbs. for the rod bolts and 75-80 ft.-lbs. for the main bearing bolts.

CRANKSHAFT REAR OIL SEAL

All Series Except 424-444-2424-2444 Non-Diesel

82. The lip type oil seal is contained in a one-piece retainer which is doweled and bolted to the rear of the cylinder block as shown in Fig. 41.

The procedure for renewing the seal is evident after splitting the engine from clutch housing and removing the clutch and flywheel.

When installing seal, press same into retainer until it bottoms against shoulder in retainer. Use a sealant on retainer and lubricate lip of seal prior to installing. The bottom face of retainer must register within 0.020 with face of crankcase.

Series 424-444-2424-2444 Non-Diesel

83. The lip type oil seal is contained in a one-piece retainer which is bolted to the rear of the crankcase.

To renew the oil seal, first split the engine from the clutch housing, then remove the clutch and flywheel. Unbolt and remove the oil seal and retainer assembly.

To install the oil seal and retainer, International Harvester recommends the following procedure: Apply sealer on gasket and retainer and using oil seal driver (IH tool No. FES 6-15) to line up retainer with crankshaft oil seal surface, install retainer to the crankcase. With the driver remaining on the crankshaft and in the retainer, tighten the cap screws in sequence (one across from the other) rotating the driver in retainer at the same time. If binding or driver occurs during the tightening of the cap screws, loosen cap screws and then repeat the tightening procedure. Remove the seal driver after all cap screws have been tightened.

Lubricate the oil seal, crankshaft flange and seal bore in the retainer. Install seal on crankshaft flange, then push seal forward by hand until the sealing lip on seal outer diameter has entered the chamfer on the retainer around the entire circumference of the seal. Position oil seal driver on crankshaft flange and drive seal forward in retainer until the shoulder of the driver contacts the rear surface of crankshaft flange.

NOTE: If special seal driver (IH tool No. FES 6-15) is not available, seal may be installed as follows: Before removing the old seal from retainer, note the depth of old seal in retainer. Install new seal in retainer in same position as old seal. Apply sealer to gasket and retainer, then install seal and retainer on crankshaft flange. Slide assembly forward on crankshaft flange and insert cap screws. Center oil seal to crankshaft flange and tighten cap screws.

FLYWHEEL

All Models

84. The flywheel can be removed after splitting engine from clutch housing and removing the clutch. To install the flywheel ring gear, heat same to approximately 500 degrees F. On Series 424, 444, 2424 and 2444 non-diesel engines, tighten flywheel bolts to a torque of 45-52 ft.-lbs. Flywheel bolts on all other series engines should be tightened to a torque of 65-70 ft.-lbs.

OIL PUMP AND RELIEF VALVE

All Models

85. The gear type oil pump is gear driven from a pinion on the camshaft and removal is evident after removing the oil pan. Overhaul of the pump is obvious after reference to Figs. 42 and 43 and to the specifications which follow:

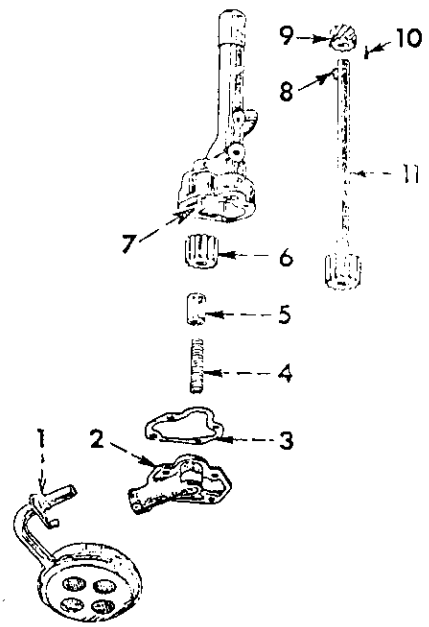


Fig. 43—Exploded view of oil pump used in Series 424, 444, 2424 and 2444 non-diesel engines.

1. Screen assy.
2. End plate
3. Gasket
4. Relief valve spring
5. Relief valve
6. Idler gear
7. Pump body
8. Woodruff key
9. Drive pinion
10. Pin
11. Gear & shaft assy.

Series 424-444-2424-2444 **non-diesel:**

Gear diametral clearance	0.0068-0.0108
Gear to end plate end play	0.0035-0.006
Gear backlash	0.004-0.006
Drive shaft operating clearance	0.001-0.0035
Idler gear to shaft clearance	0.0015-0.003
Relief valve spring free length	2.398
Relief valve opening pressure	45-55 psi

All other series:

Gear diametral clearance	0.0053-0.0083
Gear to end plate end play	0.0035-0.006
Gear backlash	0.003-0.006
Drive pinion to camshaft backlash	0.008-0.012
Drive shaft operating clearance	0.002-0.0035
Idler gear to shaft operating clearance	0.0015-0.0035
Relief valve spring free length (ball type)	2-11/32 in.
Relief valve spring free length (plunger type)	2-9/16 in.
Relief valve opening pressure	30-35 psi

GOVERNOR (NON-DIESEL)

Series B-414-354

The Series B-414 and 354 non-diesel tractors are equipped with a flyweight type governor which is mounted on left front of engine as shown in Fig. 44.

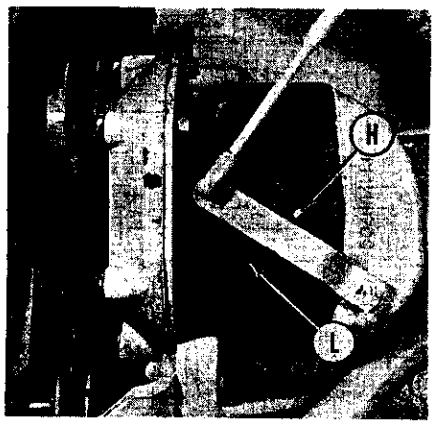


Fig. 44—Series B-414 and 354 non-diesel governor which mounts on left side of engine is shown with side cover off. Note high idle (H) and low idle (L) adjusting screws.

86. **SPEED ADJUSTMENT.** Prior to making any speed adjustments, check all operating linkage for lost motion or binding and correct any defects which may be present.

Start engine and bring to operating temperature, place throttle lever in the high idle position and check the engine high idle speed which should be 2200 rpm. Move the throttle lever to the low idle position and check the engine low idle speed which should be 500-525 rpm.

If engine speeds are not as stated, remove side cover from governor housing and adjust screw (H—Fig. 44) to correct engine high idle rpm and/or screw (L) to correct engine low idle rpm.

No surge adjustment is provided on governor assembly.

87. **R&R AND OVERHAUL.** To remove the governor assembly, it is first necessary to remove the timing gear cover as outlined in paragraph 57.

With timing gear cover off, remove drive gear retaining nut and drive gear. Disconnect throttle control rod and carburetor rod from governor levers, then remove the cap screws (S—Fig. 36) and pull governor assembly from engine front plate. Bearing (3—Fig. 45), weight carrier, weights, shaft and thrust bearing assembly can be removed from housing after removing snap ring (3). Rockshaft lever (23) and spring lever (25) and their shafts can be removed after loosening the clamping cap screws. Any further disassembly required will be obvious.

Oil seals (17) are installed with lips toward inside. Use sealant on outer edge of expansion plug (21) when renewing.

Series 424-444-2424-2444 Non-Diesel

The centrifugal flyweight type governor is mounted on the right front face of engine and is driven by the engine timing gear train. Before attempting any governor adjustments, check the operating linkage and remove any binding or lost motion.

88. **ADJUSTMENT.** To adjust the governor proceed as follows: With engine stopped, place the speed change lever in wide open position and remove clevis pin (3—Fig. 46) from the governor rockshaft arm. Hold the rockshaft arm and carburetor throttle rod (1) as far towards carburetor as they will go. If pin holes are not in alignment, adjust the length of rod (1) until pin (3) will slide freely into place. Then, lengthen rod one full turn and install clevis pin.

With engine running and speed control lever in wide open position, adjust the high idle adjusting screw (16) to obtain a high idle speed of 2200 rpm and then, lock the screw in place with the jam nut.

With engine running at low idle speed (425 rpm), quickly move the speed control lever to high idle position. If the engine surges more than twice, adjust the governor bumper spring (25) as follows: Stop engine and remove acorn nut from bumper spring adjusting screw (26). Loosen jam nut

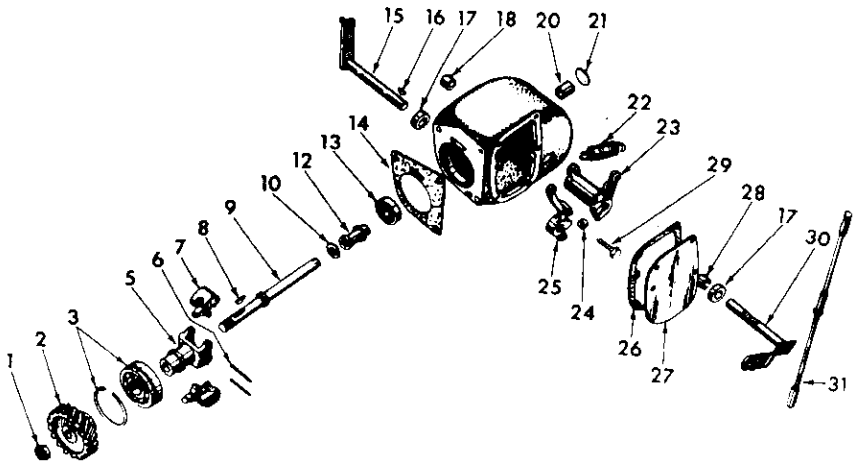


Fig. 45—Exploded view of the governor used on Series B-414 and 354 non-diesel engines.

1. Nut
2. Drive gear
3. Snap ring & bearing
5. Governor carrier
6. Pin
7. Governor weight
8. Woodruff key
9. Shaft
10. Thrust washer
12. Sleeve
13. Thrust bearing
14. Gasket
15. Speed change lever
16. Woodruff key
17. Oil seal
18. Rockshaft brg.
20. Bushing
21. Expansion plug
22. Governor spring
23. Rockshaft lever
24. Key
25. Spring lever
26. Gasket
27. Housing cover
28. Rockshaft brg.
29. Governor spring bolt
30. Rockshaft
31. Control rod

and turn screw (26) in just enough to stop excessive surging. When the bumper spring screw is properly adjusted, lock it in place with jam nut and install acorn nut.

89. **R&R AND OVERHAUL.** Remove distributor cap and mark location of rotor. Then, unbolt and remove the distributor and drive housing assembly and mark location of slots in the ignition unit drive coupling on governor gear (19—Fig. 46) in relation to crankcase. This procedure will facilitate reinstallation of governor gear in proper timing mesh with camshaft gear if position of crankshaft is not changed while governor is removed. Remove the governor speed control rod and carburetor throttle rod. Remove the grille side panels and loosen fan belt, then unbolt and remove the governor assembly from timing gear cover.

To disassemble the governor, first remove the gear and flyweight assembly. Remove the nut and lock washer from the speed control lever and shaft (6), then withdraw shaft (6) from the governor spring lever (9) and low speed spring (17). Unhook high speed spring (10) from the rockshaft fork (4) and remove governor spring lever, low speed spring and high speed spring from governor housing (15). Remove the fork (4) from rockshaft (5) and slide the rockshaft from the housing. The two needle bearings (14 and 22), "Oilite" bushing (13), and oil seals (12 and 7) can now be renewed if necessary. Flyweights and pins should be renewed when excessive wear is evident.

NOTE: A governor overhaul service package (part No. 391021R93) is available from International Harvester Co.

When reassembling the high speed spring and low speed spring to the governor spring lever, hook the upper end of high speed spring through both holes in low speed spring as shown in Fig. 47. Then, hook the lower end of the high speed spring in hole (A) of rockshaft lever (fork). Install the spring lever and low speed spring on the lever shaft. The open ends of the high speed spring hooks must be toward the center of the governor housing.

The bushing in the crankcase which supports the governor and ignition unit drive gear hub can be renewed when governor and ignition unit are off. The I&T recommended clearance of gear hub in bushing is 0.0015-0.002.

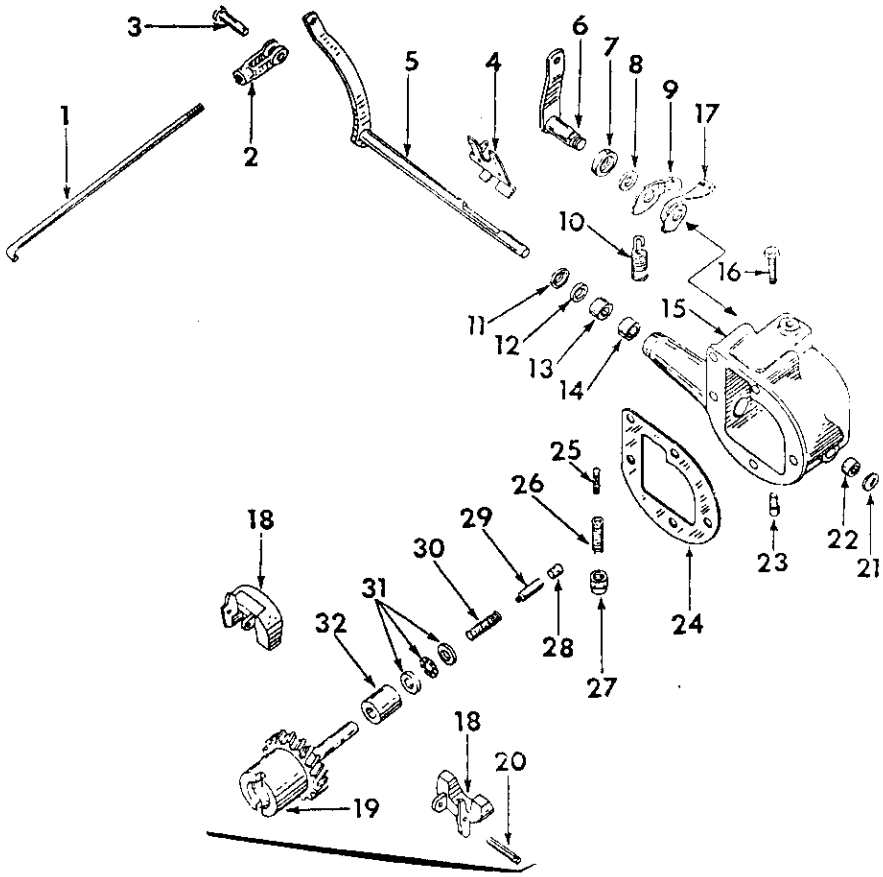


Fig. 46—Exploded view of the governor assembly used on Series 424, 444, 2424 and 2444 non-diesel engines.

1. Throttle rod
2. Clevis
3. Clevis pin
4. Rockshaft fork
5. Rockshaft
6. Speed change lever & shaft
7. Oil seal
8. Washer
9. Spring lever
10. High speed spring
11. Retainer
12. Oil seal
13. Bushing
14. Needle bearing
15. Housing
16. Speed adjusting screw
17. Low speed spring
18. Flyweights
19. Governor gear & shaft assembly
20. Flyweight pin
21. Plug
22. Needle bearing
23. Fork retainer pin
24. Gasket
25. Bumper spring
26. Bumper spring adjusting screw
27. Acorn nut
28. Shaft stop pin
29. Shaft spring pin
30. Shaft spring
31. Thrust bearing
32. Thrust sleeve

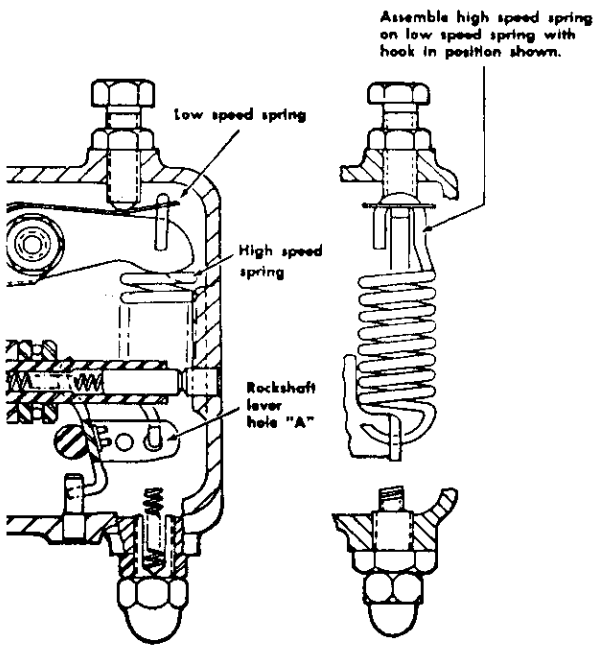


Fig. 47—View showing correct installation of high speed spring in Series 424, 444, 2424 and 2444 non-diesel governor.

DIESEL FUEL SYSTEM

Two types of injection pumps have been used on the B275 tractor. On early model tractors (prior eng. ser. no. BD-144/17289-A), a C.A.V. multiple plunger pump, fitted with a pneumatic governor was used. On later Model B-275 tractors (eng. ser. no. BD-144/17289-A and up), a C.A.V. distributor type injection pump having a mechanical type governor is used.

Series 424, 444, 2424, 2444, B-414, 354, 364 and 384 tractors also use the C.A.V. distributor pump.

When servicing any unit associated with the fuel system, the maintenance of absolute cleanliness is of utmost importance. Of equal importance is the avoidance of nicks or burrs on any of the working parts.

Probably the most important precaution that service personnel can impart to owners of diesel powered tractors, is to urge them to use an approved fuel that is absolutely clean and free from foreign material. Extra precaution should be taken to make certain that no water enters the fuel storage tanks. This last precaution is based on the fact that all diesel fuels contain some sulphur. When water is mixed with sulphur, sulphuric acid is formed and the acid will quickly erode the closely fitting parts of the injection pump and nozzles.

90. **QUICK CHECK—UNITS ON TRACTOR.** If the diesel engine does not start or does not run properly, and the diesel fuel system is suspected as the source of trouble, refer to the following list of troubles and their possible causes:

1. Sudden Stopping of Engine.
   a. Lack of fuel.
   b. Clogged fuel filter and/or lines.
   c. Faulty injection pump.
   d. Broken spring in by-pass valve.
2. Lack of Power.
   a. Improper injection pump timing.
   b. Inferior fuel.
   c. Faulty injection pump.
   d. Clogged fuel filter and/or lines.
   e. Weak or broken transfer pump plunger spring.
3. Engine Hard to Start.
   a. Inferior fuel
   b. Clogged fuel filter and/or lines.
   c. Improper injection pump timing.
   d. Faulty injection pump.
4. Irregular Engine Operation.
   a. Weak or broken governor springs.
   b. Clogged fuel filter and/or lines.
   c. Faulty nozzle.
   d. Improper injection pump timing.
   e. Faulty injection pump.
   f. Air leak in venturi vacuum pipe or governor diaphragm.
5. Engine Smokes or Knocks.
   a. Improper injection pump timing.
   b. Faulty nozzle.
   c. Inferior fuel.
6. Excessive Fuel Consumption.
   a. Improper injection pump timing.
   b. Faulty nozzle.

Many of the problems are self-explanatory; however, if the difficulty points to the fuel filter, injection nozzles and/or injection pump, refer to the appropriate paragraphs 91 through 122.

FILTER AND BLEEDING

All Models

91. When fuel lines have been disconnected or the fuel flow interrupted, bleed trapped air from the system as follows:

On early B-275 model tractors having the pneumatic governor, be sure there is sufficient fuel in tank, loosen the sediment bowl and allow same to fill, then tighten bowl. Loosen bleed screw (I—Fig. 48) on top of fuel filter and operate hand primer (P) until bubble free fuel flows, then tighten bleed screw. Loosen bleed screw (A) on injection pump and operate hand primer until bubble free fuel flows, then tighten bleed screw.

On late Model B-275 tractors with the mechanical governor and all 424, 444, 2424, 2444, B-414, 354, 364 and 384 tractors follow the same procedure except loosen both bleeder screws (A and B—Fig. 49) on the injection pump starting with the bottom one first. Primer is incorporated in fuel pump which is mounted on right side of engine.

NOTE: Models 424, 444, 2424 and 2444 diesel engines do not use the auxiliary fuel pump. Therefore, gravity flow must be used to vent the system.

On all models, loosen injector pressure lines at injectors, make sure shut-

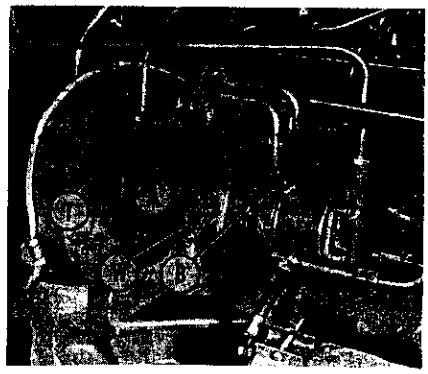


Fig. 49—Bleeder screws (A & B) on injection pump having mechanical governor.

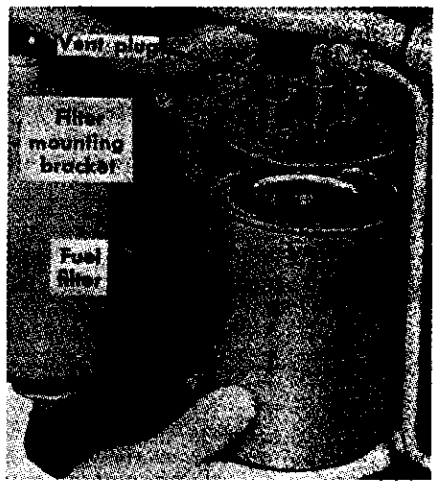


Fig. 50—When installing the diesel fuel filter on Series 424, 444, 2424 or 2444 tractor, rotate filter element until rubber seal contacts filter mounting bracket, then tighten element ¼- to ½-turn.

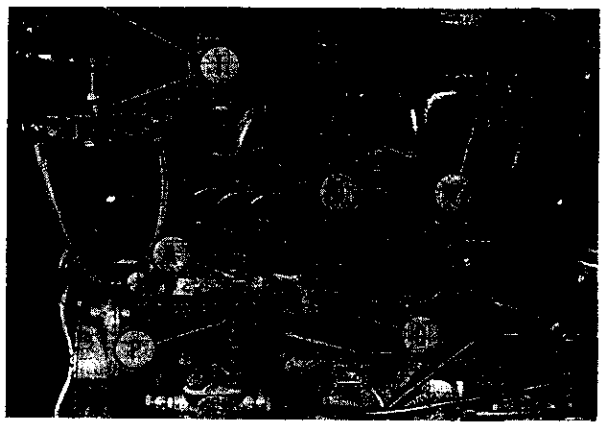


Fig. 48—Hand primer and bleed screw location on injection pump having pneumatic governor.

A. Bleed screw
D. Breather
G. Governor
I. Bleed screw
P. Hand primer
V. Venturi

off control is in the operating position and turn engine over with starting motor until fuel escapes from line ends. Tighten the pressure line connections.

INJECTOR NOZZLES

All Models

WARNING: Fuel leaves the injection nozzles with sufficient pressure to penetrate the skin. When testing, keep your person clear of the nozzle spray.

92. **TESTING AND LOCATING A FAULTY NOZZLE.** If the engine does not run properly, and a faulty injector is suspected, locate the faulty unit as follows:

If one engine cylinder is misfiring, it is reasonable to suspect a faulty injector. Generally, a faulty injector can be located by loosening the high pressure line fitting on each nozzle holder in turn, thereby allowing fuel to escape at the union rather than enter the cylinder. As in checking spark plugs in a spark ignition engine, the faulty unit is the one which, when its line is loosened, least affects the running of the engine.

93. Remove the suspected injector from the engine as outlined in paragraph 99. If a suitable nozzle tester is available, check the unit as outlined in paragraphs 94, 95, 96, 97 and 98. If a tester is not available, reconnect the fuel line to the injector and with the nozzle tip directed where it will do no harm, crank the engine with the starting motor and observe the nozzle spray pattern.

If the spray patterns are ragged, unduly wet, streaky and/or not symmetrical or, if nozzle dribbles, the nozzle valve is not seating properly and same should be cleaned and/or overhauled.

94. **NOZZLE TESTER.** A complete job of testing and adjusting the nozzle requires the use of a special tester such as that shown in Fig. 51. The nozzle should be tested for opening pressure, seat leakage, back leakage and spray pattern.

Operate the tester lever until oil flows, then attach the nozzle and holder assembly.

NOTE: Only clean approved oil should be used in the tester tank.

Close the tester valve and apply a few quick strokes to the tester lever. If undue pressure is required to operate the tester, the nozzle is plugged and same should be serviced as outlined in paragraph 100.

95. OPENING PRESSURE. While operating the tester lever, observe the gage pressure at which the spray occurs. The gage pressure should be 2130-2205 psi for models with pneumatic governor, or 2350-2425 for models with mechanical governor. On Series B-275 or B-414 injectors, if pressure is not as specified remove cap nut (3—Fig. 52) and loosen locknut (5). Turn adjusting screw (6) either way, as required, to correct opening pressure. Refer also to Fig. 53.

On Series 354, 364 and 384 injectors, add or remove shims (6—Fig. 54) as required to obtain an opening pressure of 2350 psi.

96. SEAT LEAKAGE. To check seat leakage, operate tester until gage pressure is 150 psi below nozzle operating pressure and hold this pressure for 10 seconds. Examine orifice and if drops of fuel collect at pressures below those specified, the nozzle valve is not seating properly and should be serviced as in paragraph 100.

97. BACK LEAKAGE. Test specifications for used nozzles may vary, however, if nozzle will pass the following test it may be considered satisfactory.

Pump up pressure on tester until gage registers at least 1500 psi, then as pressure starts to drop, observe the time it takes for the gage pressure to drop from 1500 to 1100 psi. A nozzle in good condition should not lose the given amount of pressure in less than 10 seconds at 60 degrees F. However, bear in mind that higher temperatures may give a time of less than the 10 seconds.

If nozzle fails to meet the foregoing test, service same as outlined in paragraph 100.

98. SPRAY PATTERN. Operate the tester handle at approximately 100 strokes per minute and observe the nozzle spray pattern. If the spray pattern is unduly wet, streaky and/or ragged, service the nozzle as outlined in paragraph 100.

99. **REMOVE AND REINSTALL.** Raise or remove hood, then before loosening any fuel lines, wash the

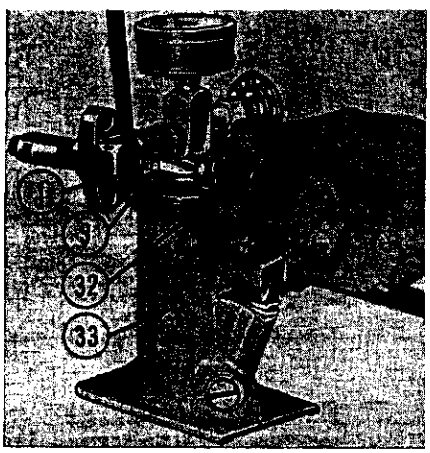


Fig. 51—Typical tester used to check and adjust injector nozzles.

1. Locknut
3. Adjusting screw
32. Screwdriver
33. Nozzle tester

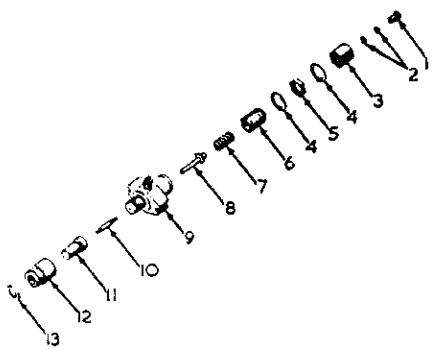


Fig. 52—Exploded view of injector nozzle and holder. Refer to Fig. 53 for a cross-sectional view.

1. Banjo bolt
2. Washers
3. Holder cap nut
4. Washers
5. Locknut
6. Adjusting screw
7. Spring
8. Spindle
9. Holder
10. Valve
11. Valve holder
12. Nozzle cap nut
13. Washer

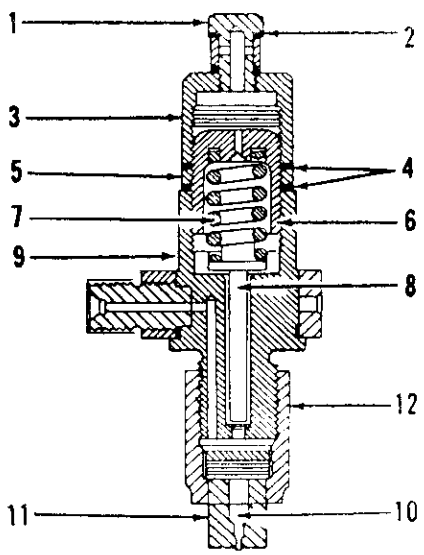


Fig. 53—Cross-sectional view of injector nozzle and holder assembly. Refer to Fig. 52 for an exploded view.

1. Banjo bolt
2. Washer
3. Cap nut
4. Washers
5. Locknut
6. Adjusting screw
7. Spring
8. Spindle
9. Holder
10. Valve
11. Valve holder
12. Nozzle cap nut

nozzle holder and connections with clean diesel fuel. After disconnecting the high pressure and leak-off lines, cover open ends of connections with composition caps to prevent the entrance of dirt or other foreign material. On Series B-414, 354, 364 and 384, remove fuel filter from inlet manifold if number two or three injector is to be removed. Remove the nozzle retaining nuts and carefully withdraw the nozzle from cylinder head, being careful not to strike the tip end of the nozzle against any hard surface. Use a suitable puller if necessary.

Thoroughly clean the nozzle recess in cylinder head before reinserting the nozzle and holder assembly. It is important that the seating surfaces of recess be free of even the smallest particles of carbon which could cause the unit to be cocked and result in blowby of hot gases. No hard or sharp tools should be used for cleaning. A piece of wood dowel or brass stock properly shaped is very effective. Do not reuse the copper ring gasket located between nozzle and precombustion chamber holder, always install a new one. Tighten the nozzle holder stud nuts to a torque of 40-50 ft.-lbs. for Series B-275; or 30-35 ft.-lbs. for Series B-414, 424, 444, 2424, 2444, 354, 364 and 384.

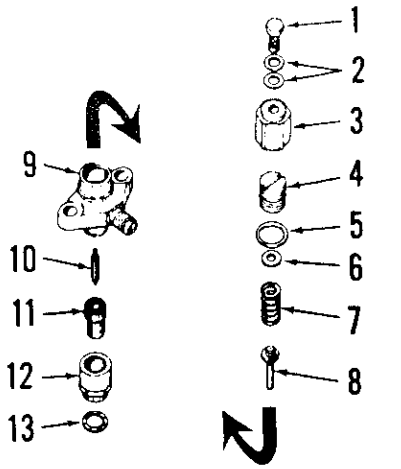


Fig. 54—Exploded view of injector nozzle and holder, used on 354, 364 and 384 diesel.

1. Banjo bolt
2. Washers
3. Holder cap nut
4. Spring cap
5. Washer
6. Shim
7. Spring
8. Spindle
9. Holder
10. Valve
11. Valve holder
12. Nozzle cap
13. Washer

100. **MINOR OVERHAUL (CLEANING) OF NOZZLE VALVE AND BODY.** Hard or sharp tools, emery cloth, crocus cloth, grinding compounds or abrasives of any kind should NEVER be used in the cleaning of nozzles.

Wipe all dirt and loose carbon from the nozzle and holder assembly with a clean, lint free cloth. Carefully clamp nozzle holder assembly in a soft jawed vise and remove the cap nut (3—Fig. 52 or 54). On Series B-275, B-414, 424, 444, 2424 and 2444, loosen jam nut (5—Fig. 52) and back-off the adjusting screw (6) enough to relieve load from spring (7). On Series 354, 364 and 384, back-off spring cap (4—Fig. 54) to relieve load from spring (7).

On all series remove the nozzle cap nut (12—Fig. 52 or 54) and nozzle body (11). Normally, the nozzle valve (10) can be easily withdrawn from the nozzle body. If the valve cannot be easily withdrawn, soak the assembly in fuel oil or carbon solvent to facilitate removal. Be careful not to permit the valve or body to come in contact with any hard surface.

Examine the nozzle body and remove any carbon deposits from exterior surfaces using a brass wire brush. The nozzle body must be in good condition and not blued due to overheating. All polished surfaces should be relatively bright, without scratches or dull patches. Pressure surfaces (A, B and J—Fig. 56) must be absolutely clean and free from nicks, scratches or foreign material, as these surfaces must register together to form a high pressure joint.

Clean out the small fuel feed channels (C), using a small diameter wire. Insert a suitable groove scraper into nozzle body until nose of scraper locates in fuel gallery (F); then, press nose of scraper hard against side of cavity and rotate scraper to clean all carbon deposits from the gallery. Clean all carbon from valve seat (G), using a suitable seat scraper.

Use a pintle hole cleaning probe of appropriate size and pass the probe down the bore of the nozzle body until probe protrudes through the orifice; then, rotate the probe until all carbon is cleared.

Examine the pintle and seat end of the nozzle valve and remove any carbon deposits using a brass wire brush. Use care, however, as any burr or small scratch may cause valve leakage or spray pattern distortion. If valve seat (M—Fig. 56) has a dull circumferential ring indicating wear or pitting or if valve is blued, the valve and body should be turned over to an official diesel service station for possible overhaul.

Before reassembling, thoroughly rinse all parts in clean diesel fuel and make certain that all carbon is removed from the nozzle holder nut. Install nozzle body and holder nut, making certain that the valve stem is located in the hole of the holder body. Tighten the holder nut to a torque of 50 ft.-lbs.

NOTE: Over-tightening may cause distortion and subsequent seizure of the nozzle valve.

Test the injector as in paragraphs 94, 95, 96, 97 and 98. If the nozzle does not leak and if the spray pattern is satisfactory, the nozzle is ready for use. If the nozzle will not pass the leakage and spray pattern tests, renew the nozzle valve and seat, which are available only in a matched set; or, send the nozzle and holder assembly to an official diesel

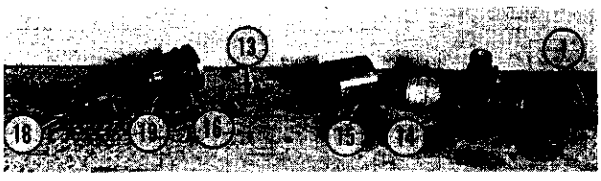


Fig. 55—View showing injector assembly, precombustion chamber holder, precombustion chamber and glow plug removed from engine.

1. Banjo bolt
13. Washer
14. Injector
15. Precombustion chamber holder
16. Washer
18. Glow plug
19. Precombustion chamber

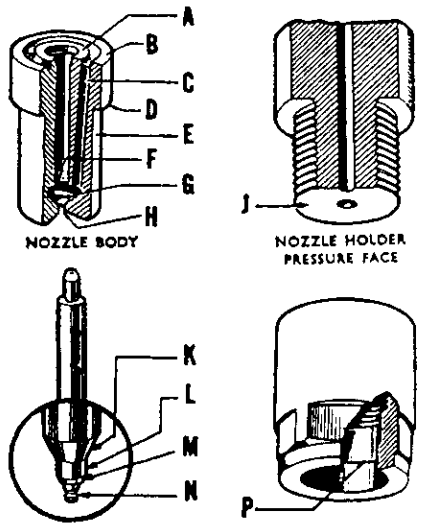


Fig. 56—Views of nozzle and holder showing various points for detailed cleaning and inspection.

A. Nozzle body pressure face
B. Nozzle body pressure face
C. Fuel feed hole
D. Shoulder
E. Nozzle trunk
F. Fuel gallery
G. Valve seat
H. Pintle orifice
J. Holder pressure face
K. Valve cone
L. Stem
M. Valve seat
N. Pintle
P. Nozzle retaining shoulder

service station for a complete overhaul which includes reseating the nozzle valve cone and seat.

101. **OVERHAUL OF NOZZLE HOLDER.** On Series B-275, B-414, 424, 444, 2424 and 2444, refer to Fig. 52 and remove cap (3). Remove jam nut (5) and adjusting screw (6). Withdraw spring (7) and spindle (8). On Series 354, 364 and 384 refer to Fig. 54 and remove cap (3). Remove spring cap (4) and shims (6). Withdraw spring (7) and spindle (8).

On all models, thoroughly wash all parts in clean diesel fuel and examine the end of the spindle which contacts the nozzle valve stem for any irregularities. If the contact surface is pitted or rough, renew the spindle. Renew any other questionable parts.

Reassemble the nozzle holder and leave the adjusting screw locknut loose until after the nozzle opening pressure has been adjusted as outlined in paragraph 95.

PRE-COMBUSTION CHAMBERS

All Models

102. The necessity for cleaning the pre-combustion chambers is usually indicated by excessive smoking or when fuel economy drops.

To remove the precombustion chambers, first remove injector nozzles as outlined in paragraph 99. Remove glow plug wires and glow plugs. Precombustion chambers can now be removed.

NOTE: In cases where precombustion chambers are stuck extremely tight, it may be necessary to remove cylinder head as outlined in paragraphs 39 and 43.

When reinstalling precombustion chambers, use new gaskets and be sure glow plug bores are aligned. Misaligned bores could cause the glow plug to contact the precombustion chamber and result in a short circuit.

INJECTION PUMP

All Models

The subsequent paragraphs will outline ONLY the injection pump service work which can be accomplished without the use of special, costly pump testing equipment. If additional service work is required, the pump should be turned over to an offical Diesel service station for overhaul. Inexperienced service personnel should never attempt to overhaul a Diesel injection pump.

103. **TIMING TO ENGINE, (PNEUMATIC GOVERNOR).** To check and adjust the injection pump timing on models equipped with pump having pneumatic governor, proceed as follows: Disconnect the number one or number four injector line from pump, remove the delivery valve holder, withdraw its valve and spring, then reinstall the delivery valve holder. Attach a gooseneck or bent tube to the delivery valve holder. Remove the pump side cover, place speed control lever in maximum speed position and check to be sure rack is in delivery position. Turn engine in direction of normal rotation, until pump plunger starts to lift, then operate primer pump to maintain fuel pressure in fuel gallery. Continue to turn engine in same direction until fuel flow from spill line decreases. Stop engine rotation at this instant.

NOTE: Spill cut-off point is when fuel flow decreases to two to four drops of fuel per second at full fuel gallery pressure.

Measure the distance around the circumference of the crankshaft pulley from marker in pulley to timing pointer. This distance should be 1-1/8 inches which equals 20 degrees BTDC.

NOTE: While 20 degrees BTDC is considered optimum, timing can be retarded as far as 16 degrees BTDC in cases where engine noise is critical and power requirements are not exacting. However, timing should not be advanced more than 22 degrees BTDC or maximum power will be reduced and glow plug failure will be increased. If necessary, the timing angle can be found as follows: (A) Multiply the distance measured on crankshaft pulley by 360. (B) Multiply pulley diameter by 3.14. (C) Divide (B) into (A).

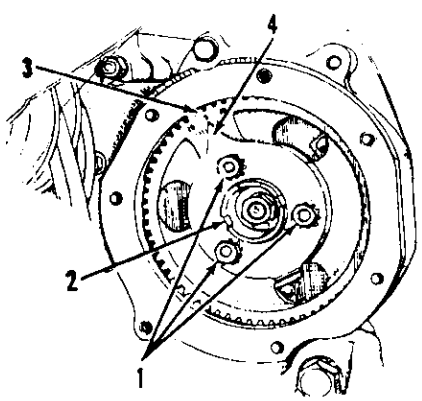


Fig. 57—Injection pump drive gear used on early B-275 tractors equipped with injection pump having pneumatic governor.

1. Cap screws
2. Hub groove
3. Pump gear
4. Timing pointer

To change the injection pump timing, first remove the injection pump drive gear cover from timing gear cover. Refer to Fig. 57 and loosen the three cap screws (1). Turn indicator (4) clockwise to advance timing, or counterclockwise to retard. One division on the injection pump drive gear equals four degrees on the engine crankshaft.

Reassemble by reversing disassembly procedure and torque the delivery valve holder to 30 ft.-lbs. Bleed the fuel system as in paragraph 91.

104. **TIMING TO ENGINE (MECHANICAL GOVERNOR).** The injection pump drive shaft and the drive gear adapter are equipped with a master spline. As long as the pump drive gear is in proper relation to the engine timing gear train as shown in Fig. 35, the pump may be installed at any time without regard to crankshaft or timing mark location. When a new injection pump, pump drive gear or drive gear adapter is installed, or when incorrect pump timing is suspected, the pump timing can be checked as follows: Shut off fuel and remove injection pump timing window and clutch housing dust cover. Turn engine in direction of normal rotation until No. 1 piston is coming up on compression stroke and continue turning engine until the "TDC" mark on flywheel aligns with the scribe mark located on left front flange of clutch housing. Check the timing marks on engine front end plate and pump mounting flange as shown at (T) in Fig. 49. If alignment is required, loosen nuts on pump mounting studs, align the mark on pump mounting flange midway between the two marks on the engine front end plate and retighten nuts. At this time the "E" scribed line on injection pump rotor should align with the scribed lines at the lower hole of the pump snap ring.These marks are visible after removing cover (W).

NOTE: Movement of the pump between the two scribed lines on the engine front end plate gives a variation of approximately three degrees.

105. **REMOVE AND REINSTALL (PNEUMATIC GOVERNOR).** Before removing injection pump, thoroughly wash pump and all connections with clean diesel fuel. Shut off fuel and disconnect the fuel supply line at the primary pump. Disconnect the fuel pump to fuel filter line at fuel pump. Disconnect fuel filter to injection pump line at injection pump. Disconnect and remove injector lines.

NOTE: Use plastic caps and plugs to seal all openings of lines and pump to prevent entry of foreign material.

Remove the two lines between injection pump governor and intake venturi. Disconnect stop control rod at injection pump. Remove the injection pump drive gear from the timing gear cover, then remove the cap screws which retain timing pointer and drive gear to injection pump hub. Rotate injection pump gear until holes in same align with mounting cap screws and remove cap screws. Remove cap screws from injection pump mounting flange, then remove the injection pump.

Reinstall by reversing the removal procedure and bleed fuel system as in paragraph 91.

106. **REMOVE AND REINSTALL (MECHANICAL GOVERNOR).** Before removing injection pump, thoroughly wash pump and all connections with clean diesel fuel. Remove the breather line between injection pump drive gear cover and inlet manifold, then remove the injection pump drive gear cover from timing gear cover. Disconnect control rod and fuel shut-off rod from pump. Shut off fuel and disconnect injection pump supply line at injection pump. Disconnect excess fuel line from injection pump and pressure lines from injectors.

NOTE: Use plastic caps and plugs to seal all openings of lines and pump to prevent entry of foreign material.

Unbolt injector pump drive gear from pump hub, then unbolt and remove injection pump with pressure lines attached. Pressure lines can now be removed, if necessary.

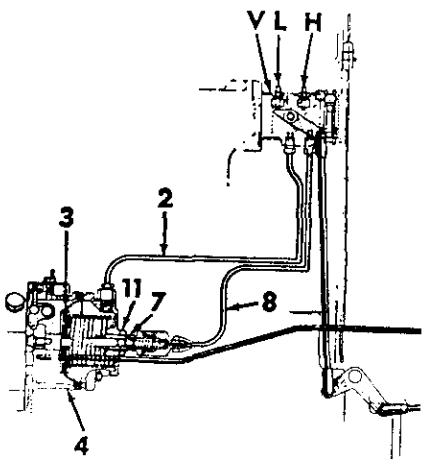


Fig. 58—Schematic view showing governor assembly, venturi and the connecting pipes used on early B-275 tractors.

H. High idle adjusting screw
L. Low idle adjusting screw
V. Venturi
2. Vacuum line
3. Diaphragm
4. Housing
7. Idle valve
8. Pitot line
11. Locknut

NOTE: On Series B-414, 354, 364 and 384, injection pump removal will be eased if fuel filter is removed from inlet manifold.

Reinstall by reversing the removal procedure and bleed fuel system as in paragraph 91. Check timing marks as outlined in paragraph 104.

107. **GOVERNOR (PNEUMATIC).** The pneumatic governor is actuated by vacuum in the venturi of the engine air induction system.

108. ADJUSTMENT. Recommended governed speeds are as follows:

Pneumatic Governor

Engine high idle rpm	2075
Engine rated rpm	1875
Engine low idle rpm	570
Belt pulley high idle rpm	1479
Belt pulley rated rpm	1336
Belt pulley low idle rpm	407
Pto high idle rpm	614
Pto rated rpm	555
Pto low idle rpm	169

To adjust the governor, first make sure the air cleaner is properly serviced and that no leaks are present in the venturi, governor housing or piping. Check travel of venturi cross shaft and be sure it contacts the limit stops at the extremes of hand lever positions. Adjust link rod length if necessary, to obtain correct travel.

Loosen the idling valve locknut (11—Fig. 58), remove pitot line connections and screw idle valve (7) out until the stem is completely clear of the diaphragm. Tighten locknut. Start engine and run same at high idle for approximately 15 minutes and when both the temperature and rpm have stabilized, check the idle valve for leakage by placing finger over end of valve. If the engine rpm decreases, the valve is leaking and same should be removed, cleaned and inspected to determine the cause.

With idle valve installed and the engine temperature and high idle rpm stabilized, check the engine high idle which should be 2075 rpm. If high idle rpm is not as specified, turn adjusting screw (H—Fig. 59) as required. Tighten locknut and recheck.

109. IDLE (DAMPER) VALVE. Although this valve can be adjusted at low idle, the following procedure will preclude the possibility of over adjustment which can cause poor governor action.

With pitot line removed, start engine and run same at high idle until both engine temperature and rpm have stabilized. Now with engine running at high idle, slowly turn idle valve inward until engine rpm decreases 20 to 30 rpm. Tighten locknut and connect pitot line.

110. To check the engine low idle rpm, place the hand lever in low idle position and check to see that the venturi cross shaft lever is against the stop. Check the engine low idle speed which should be 570 rpm. If engine rpm is not as specified, turn screw (L—Fig. 59) as required. Tighten locknut and recheck.

111. GOVERNOR DIAPHRAGM. The governor diaphragm is made from specially prepared leather and any pin holes or fractures in same will result in faulty governor action.

To test the diaphragm, proceed as follows: With engine stopped, disconnect both lines from the governor unit. Move the stop control lever to the stop position, place a finger over each of the two holes from which the lines were removed, then release the stop lever. The control rod should remain stationary and any movement of the control rod indicates leakage either at diaphragm, housing or housing cover joints.

To renew the governor diaphragm, disconnect pitot line (8—Fig. 58) from governor housing cover, then remove governor housing cover and spring. Pull diaphragm rim from its recess and pull as far from governor housing as possible. Push the control rod as far back as it will go, then turn diaphragm 90 degrees, slide toward top of housing and remove.

When reassembling, tighten the governor housing screws securely. Check and adjust if necessary, the governed speeds as outlined in paragraphs 108, 109 and 110.

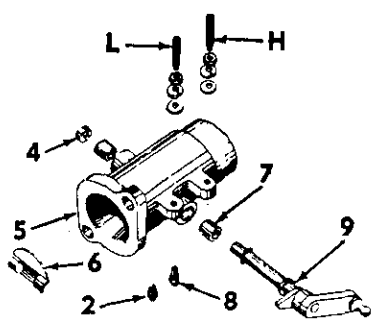


Fig. 59—Exploded view of the venturi and component parts used on early B-275 tractors fitted with injection pump having pneumatic governor.

H. High speed adjusting screw
L. Low speed adjusting screw
2. Vacuum tube
4. Plug
5. Housing
6. Throttle valve
7. Bushing
8. Pitot tube
9. Spindle

112. **GOVERNOR (MECHANICAL).** The mechanical governor is an integral part of the injection pump and if service is required, the pump should be turned over to an official diesel service station.

113. ADJUSTMENT. Recommended governed speeds are as follows:

Series B-275

Engine high idle rpm	2000
Engine rated rpm	1900
Engine low idle rpm	530-580
Pto high idle rpm	595
Pto rated rpm	563
Pto low idle rpm	158-176

Series B-414-424-444-2424-2444

Engine high idle rpm	2200
Engine rated rpm	2000
Engine low idle rpm,	
B-414-424-2424	550
444-2444	650
Pto high idle rpm	600
Pto rated rpm	545
Pto low idle rpm,	
B-414-424-2424	150
444-2444	177

Series 354

Engine high idle rpm	2075
Engine rated rpm	1900
Engine low idle rpm	550
Pto high idle rpm	615
Pto rated rpm	556
Pto low idle rpm	163

Series 364-384

Engine high idle rpm	2310
Engine rated rpm	2100
Engine low idle rpm	550
Pto high idle rpm	634
Pto rated rpm	573
Pto low idle rpm	150

To adjust the governor, first start engine and bring to normal operating temperature. Move the speed control hand lever to the high idle position at which time the engine high idle should be 2000 rpm for Series B-275, 2200 rpm for Series 424, 444, 2424, 2444 and B-414, 2075 rpm for Series 354 and 2310 for 364 and 384. If engine rpm is not as specified, loosen locknut and turn the high idle adjusting screw (H- Fig. 60) as required. Tighten locknut and recheck.

With engine high idle rpm properly adjusted, move the speed control hand lever to the low idle position at which time the engine low idle should be 530-580 rpm on Series B-275, 550 rpm on Series B-414, 354, 364, 384, 424 and 2424 or 650 rpm on Series 444 and 2444. If engine rpm is not as specified, loosen locknut and turn low idle adjusting screw (L—Fig. 60) as required. Tighten locknut and recheck.

VENTURI

Series B-275

114. **R&R AND OVERHAUL.** To remove the venturi, raise hood and loosen clamp which retains air cleaner hose to venturi. Remove air cleaner cup, then unbolt air cleaner clamp and remove air cleaner. Disconnect control rod from venturi cross-shaft, then unbolt and remove venturi from inlet manifold.

Further disassembly and/or overhaul is obvious after an examination of the unit and reference to Fig. 59.

FUEL PUMP

Series B-275-B-414-354-364-384

115. When tractor is fitted with an injection pump having a pneumatic governor a fuel pump such as that shown in Figs. 61 and 62 is used. On tractors which are fitted with the injection pump having a mechanical governor a pump such as that shown in Figs. 63 and 64 is used.

116. **TESTING.** The fuel pump used in conjunction with the pneumatic governed injection pump can be tested by mounting injection pump and fuel pump on test stand and proceeding as follows:

117. SUCTION TEST. With injection pump running at 700 rpm, fuel pump should deliver fuel in 60 seconds through dry hoses from a 2-foot suction head.

118. DELIVERY TEST. At 700 injection pump rpm, fuel pump should deliver a minimum of 300 cubic centimeters of fuel in 30 seconds from a 2-ft. suction head.

119. MAXIMUM PRESSURE TEST. With injection pump running at 700

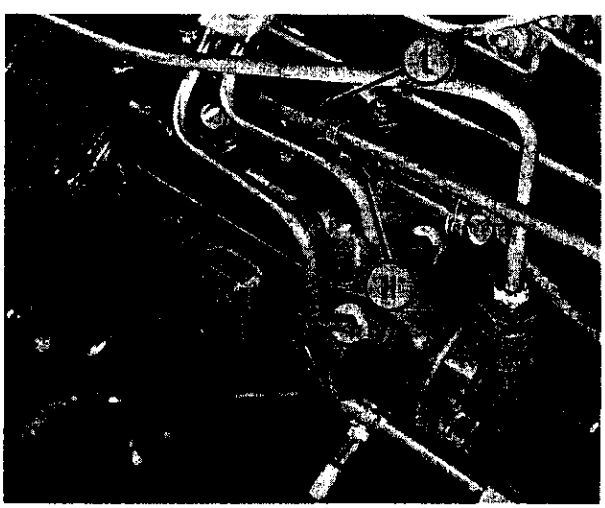


Fig. 60—On late B-275 and all B-414, 354, 364, 384, 424, 444, 2424 and 2444 tractors having injection pump fitted with mechanical governor the high (H) and low (L) idle speed adjusting screws are located as shown.

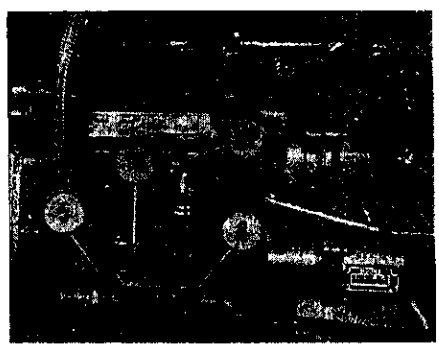


Fig. 61—When tractor is fitted with an injection pump having a pneumatic governor, the fuel pump is bolted to the side of the injection pump as shown.

5. Housing
8. Plug
18. Valve guide
HP. Hand primer

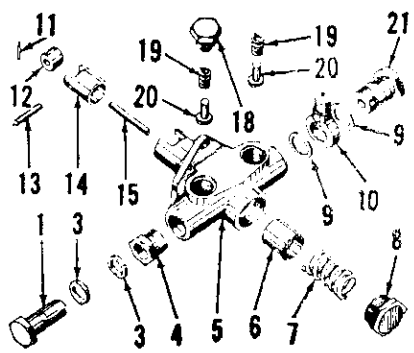


Fig. 62—Exploded view of fuel pump shown in Fig. 61. Hand primer lever is not shown.

1. Outlet stud
3. Washers
4. Nipple
5. Housing
6. Plunger
7. Spring
8. Plug
9. Washers
10. Threaded connection
11. Retaining pin
12. Tappet roller
13. Roller pin
14. Tappet guide
15. Tappet spindle
18. Valve guide
19. Springs
20. Valves
21. Inlet stud

rpm, fuel pump should maintain an outlet pressure of 5-7 psi.

120. VALVES TEST. With maximum pump pressure built up and pump stopped, the maximum pressure should not decrease by more than 0.5 psi in 20 seconds.

121. **R&R AND OVERHAUL.** To remove and overhaul the fuel pump used on models with pneumatic governed injection pump, proceed as follows:

Shut off fuel and disconnect fuel inlet and outlet lines from pump body. Refer to Fig. 62 and remove hand primer and valve guide (18). Lift out springs (19) and valves (20). Remove plug (8) and spring (7). The pump housing can now be removed from injection pump.

NOTE: Above disassembly should be done prior to removing pump housing from injection pump as pump housing can be easily damaged if clamped in a vise.

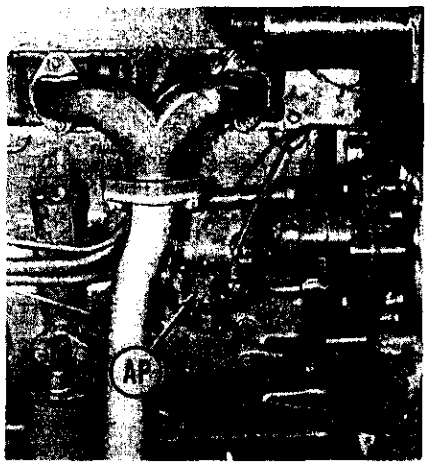


Fig. 64—View of B-275 tractor showing the auxiliary fuel pump (AP) used when tractor is equipped with an injection pump having a mechanical governor. B-414, 354, 364 and 384 tractors are similar.

With pump housing removed, invert same and shake out plunger (6) and tappet spindle (15). If necessary, the tappet roller (12) and tappet guide (14) can be disassembled by driving out pin (11).

Clean all parts and inspect valves and their seats in the pump housing. All seating surfaces should be clean and smooth. Renew any pitted, worn or damaged valves. Inspect all springs and renew those which are rusted, distorted or show signs of being fractured. Inspect tappet assembly and pay particular attention to the roller and its pin. If wear is excessive, renew both parts. Inspect plunger (6) for scoring, pitting, wear or hammering from spindle (15) and if excessive wear or damage is found, it is recommended that both plunger (6) and housing (5) be renewed. Inspect the condition of the tappet spindle (15) gland washer, which is located in the pump housing, and renew same if necessary.

Reassemble by reversing the disassembly procedure and if necessary, test pump as outlined in paragraphs 117 through 120.

122. The fuel pump used when tractor is equipped with an injection pump having a mechanical governor is conventional and the removal and/or overhaul is obvious after an examination of the unit and reference to Figs. 63 and 64.

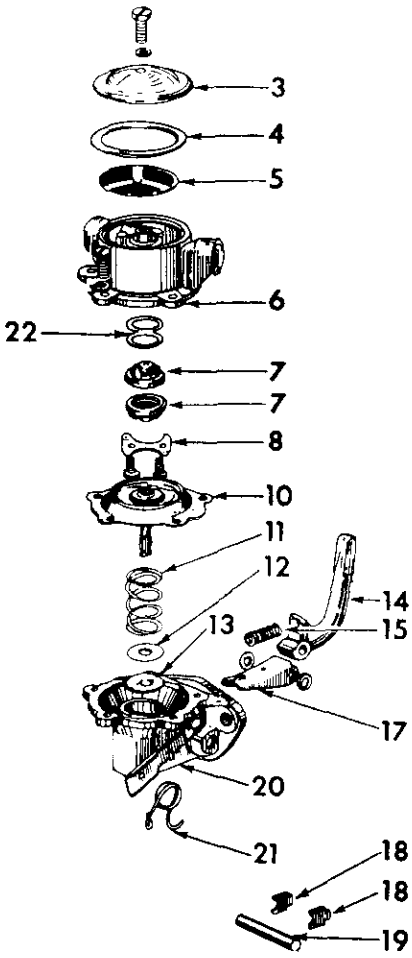


Fig. 63—Exploded view of fuel pump used on late Series B-275 and all Series B-414, 354, 364 and 384 tractors. Diesel and non-diesel pumps are similar.

3. Cover
4. Gasket
5. Filter screen
6. Valve body
7. Valves
8. Valve retainer
10. Diaphragm assy.
11. Spring
12. Washer (metal)
13. Washer (fabric)
14. Rocker arm
15. Spring
17. Link
18. Pin retainers
19. Rocker arm pin
20. Body & hand primer
21. Spring
22. Valve gasket

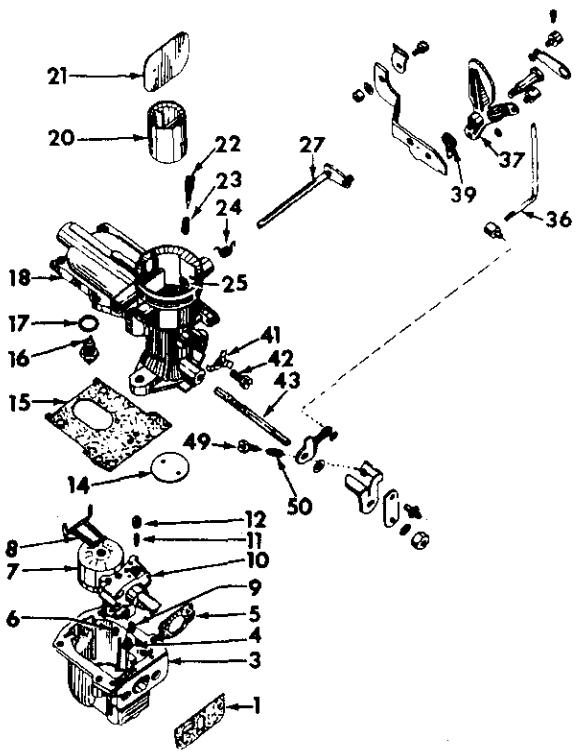


Fig. 65—Exploded view of the Zenith downdraft carburetor used on early Series B-414 and 354 non-diesel tractors.

1. Gasket
3. Bowl
4. Main jet
5. Gasket
6. Bleed jet
7. Float
8. Float arm & pivot
9. Compensating jet
10. Emulsion block
11. Idle jet
12. Plug
14. Throttle plate
15. Gasket
16. Float needle
17. Washer
18. Barrel assembly
20. Choke tube
21. Choke plate
22. Idle mixture adjusting screw
23. Spring
24. Spring
27. Choke shaft & lever
36. Interconnection rod
37. Choke control lever
39. Spring
41. Tab washer
42. Choke tube retaining screw
43. Throttle shaft
49. Stop screw
50. Spring

FUEL SYSTEM (NON-DIESEL)

CARBURETOR

Series B-414-354

123. The early production B-414 non-diesel tractors (prior to engine serial No. BC-144/3525) and all 354 non-diesel tractors were equipped with an English built, Model VNN, Zenith downdraft carburetor. On later production B-414 tractors, the carburetor used is the Model VNP Zenith downdraft which is equipped with an accelerator pump.

124. R&R AND OVERHAUL. Removal of the carburetor is obvious upon examination of the unit.

With carburetor removed, separate the bowl cover and barrel from bowl, then remove float and emulsion block from bowl. Jets can now be removed from emulsion block and the fuel inlet needle valve assembly removed from bowl cover. Remove choke plate and shaft, then remove set screw and pull choke tube from barrel.

On Model VNP carburetor, remove piston retaining screw and withdraw accelerator piston and spring. Then, unscrew and remove the accelerator pump check valve.

Any further disassembly required on either model will be obvious upon examination of the unit and reference to Fig. 65 or 66.

Reassemble by reversing the disassembly procedure. Float level is non-adjustable.

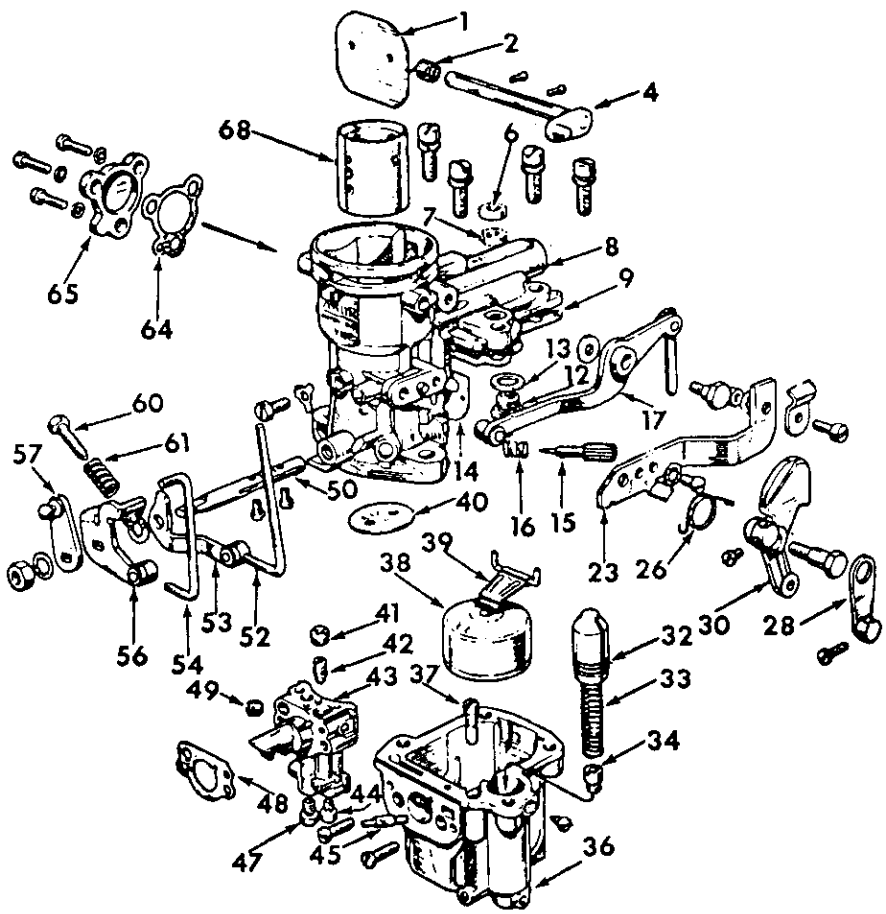


Fig. 66—Exploded view of Model VNP Zenith downdraft carburetor used on late Model B-414 tractors.

1. Choke plate
2. Spring
4. Choke shaft
6. Retainer
7. Felt washer
8. Carburetor barrel
9. Gasket
12. Inlet needle & seat
13. Washer
14. Gasket
15. Idle mixture needle
16. Spring
17. Pump lever
23. Bracket
26. Spring
28. Choke link
30. Choke lever
32. Pump piston
33. Pump spring
34. Check valve
36. Carburetor bowl
37. Discharge valve
38. Float
39. Float arm
40. Throttle plate
41. Plug
42. Idle jet
43. Emulsion block
44. Compensating jet
45. Pump jet
47. Main jet
48. Gasket
49. Ventilating screw
50. Throttle shaft
52. Rod
53. Lever
54. Pump link
56. Throttle stop
57. Throttle lever
60. Throttle stop screw
61. Spring
64. Gasket
65. Blanking plate
68. Choke tube

Series 424-444-2424-2444

125. The carburetor used on Series 424, 444, 2424 and 2444 tractors is the Marvel-Schebler Model TSX 896. The 1-1/8-in. updraft carburetor is equipped with a fuel solenoid shut-off valve which prevents engine from "dieseling" when ignition is switched to off position.

126. **R&R AND OVERHAUL.** Removal of the carburetor is obvious upon examination of the unit.

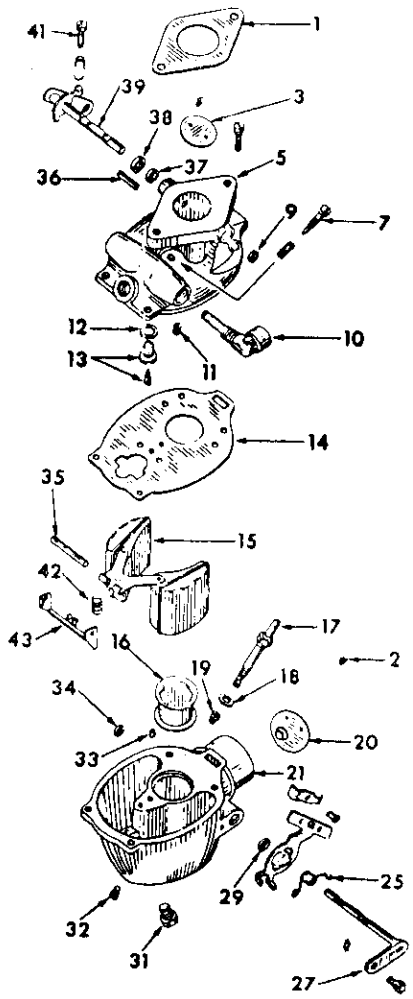


Fig. 67—Exploded view of the Marvel-Schebler Model TSX896 carburetor used on Series 424, 444, 2424 and 2444 tractors.

1. Gasket
3. Throttle plate
5. Throttle body
7. Idle mixture needle
9. Throttle shaft cup
10. Fuel inlet screen
11. Idle jet
12. Gasket
13. Fuel inlet valve
14. Gasket
15. Float
16. Venturi
17. Main nozzle
18. Gasket
19. Power jet
20. Choke plate
21. Fuel bowl
25. Spring
27. Choke shaft
29. Packing
31. Drain plug
32. Plug
33. Vent
34. Choke shaft cup
35. Float axle
36. Throttle stop
37. Packing
38. Retainer
39. Throttle shaft
41. Throttle stop screw
42. Float spring
43. Spring bracket

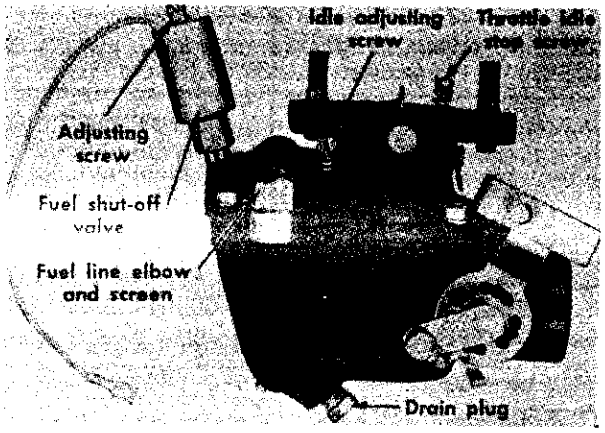


Fig. 68—View showing adjusting screws on Marvel-Schebler Model TSX896 carburetor. Main fuel adjusting screw is on fuel solenoid shut-off valve.

With carburetor removed, first remove the fuel solenoid shut-off assembly, then unbolt and separate the throttle body from fuel bowl. Remove float and fuel inlet needle valve assembly from the throttle body. Jets can now be removed from throttle body and fuel bowl. Any further disassembly required will be obvious upon examination of the unit and reference to Figs. 67 and 68.

Reassemble by reversing the disassembly procedure. Float setting and parts data are as follows:

Float setting	¼-in.
Repair kit	286-1465
Gasket set	16-613
Inlet needle and seat	233-608
Idle jet	49-345
Nozzle	47-277
Power jet	49-188

The power adjusting needle on fuel solenoid shut-off valve should be adjusted to four turns off its seat for correct adjustment. The initial setting for the idle mixture needle is one full turn open. Adjust the throttle stop screw to obtain the correct engine low idle speed of 425 rpm.

FUEL PUMP

Series B-414-354

127. The fuel pump used on Series B-414 and 354 non-diesel tractors is a conventional diaphragm type. Removal, installation and overhaul of the pump will be obvious upon examination and reference to Fig. 63.

Series 424-444-2424-2444

128. An "Autopulse" electric fuel pump (IH part No. 391586R91) was used on early production Series 424 and 2424 non-diesel tractors. Late production Series 424 and 2424 and all Series 444 and 2444 non-diesel tractors are equipped with a "Bendix" electric fuel pump (IH part No. 394327R91). Removal of either pump is obvious upon examination of the unit.

COOLING SYSTEM

RADIATOR

Series B-275-B-414-354-364-384

129. To remove radiator, drain cooling system and on Series B-275 and B-414, lift hood, remove cotter pins from ends of stayrod channels and move hood to a vertical position. Disconnect radiator brace and on Series B-275, the fuel filter brace from radiator. On Series 354, 364 and 384 remove hood and grille support, then remove air cleaner hose from air cleaner and disconnect the horn wire. On all series, disconnect upper and lower hoses from radiator, then unbolt radiator from front support and lift from tractor. Fan shroud can now be removed, if necessary.

Radiator is of one-piece construction with non-detachable upper and lower tanks.

Reinstall by reversing the removal procedure.

Series 424-444-2424-2444

130. To remove radiator, drain cooling system and remove hood and side panels. Disconnect radiator hoses and unbolt the radiator brace. Unbolt the fan shroud and lay same back over fan. Remove nuts from lower support bolts and lift radiator from tractor.

Radiator is of one-piece construction with non-detachable upper and lower tanks.

Reinstall by reversing the removal procedure.

THERMOSTAT

All Models

131. Thermostat is located in the water outlet elbow and the removal procedure is evident. Standard thermostat for all B-275 and early production B-414 tractors begins to open at 176 degrees F and is fully open at 190 degrees F. On late production B-414 tractors starting with engine serial numbers BC-144/6029 and BD-154/32795 and all 354, 364, 384, 424, 444, 2424 and 2444 tractors, standard thermostat begins to open at 170 degrees F and is fully open at 199 degrees F.

WATER PUMP

Series B-275-B-414-354-364-384

132. **R&R AND OVERHAUL.** To remove the water pump, first remove the radiator as outlined in paragraph 129, then loosen the water pump pulley flange, or bracket on those models with belt adjusting attachment, and remove

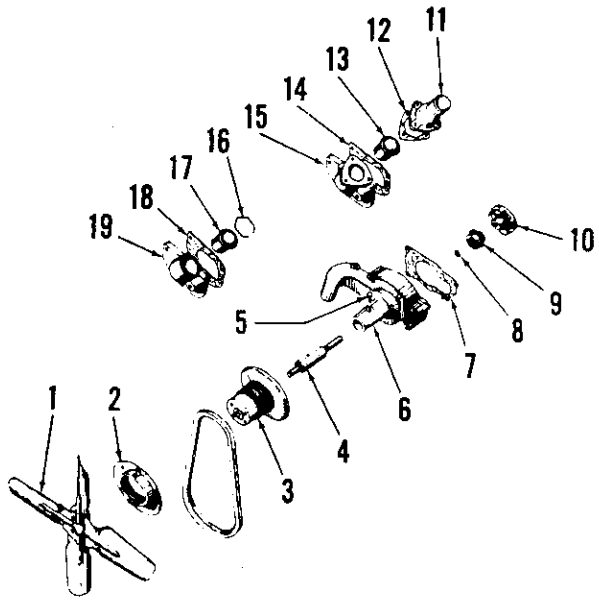


Fig. 69—Exploded view showing component parts of the water pump assembly and thermostat housing used on Series 354, 364, 384 and late B-414. Items 16, 17, 18 and 19 are used on Series B-275 and early B-414.

1. Fan
2. Pulley flange
3. Pulley hub
4. Shaft & brg. assy.
5. Set screw
6. Housing
7. Gasket
8. Flinger
9. Seal
10. Impeller
11. Cover thermostat housing
12. Gasket
13. Thermostat
14. Gasket
15. Thermostat housing
16. Retaining ring
17. Thermostat
18. Gasket
19. Thermostat housing

fan belt. Loosen alternator or generator adjustment strap and remove alternator or generator belt. Unbolt and remove water pump.

To disassemble water pump, refer to Fig. 69 and remove fan blades (1) and pulley flange (2). Pulley hub (3) can now be pressed from pump shaft (4). With pump hub removed, remove set screw (5), then press shaft, bearing, seal and impeller rearward out of housing. Shaft can now be pressed from impeller.

Inspect all parts for excessive rust or scale and for undue wear or damage. Both impeller and pulley hub must fit pump shaft with no less than 0.001 interference fit. Pump shaft bearing fit in housing is from 0.0003 loose to 0.0008 tight. Renew any parts which do not meet the above conditions.

Reassemble pump by reversing the disassembly procedure. Longest section of pump shaft is toward impeller end of housing. Install new seal (9). Press impeller and pulley hub on pump shaft until they are flush with ends of shaft and when pressing on pulley hub be sure that impeller end of shaft is supported. Do not subject pump housing to the pressing pressure.

After assembly, turn pump by hand to see that it rotates freely. As a further check for correct assembly, measure the distance between fan mounting surface of pulley hub and mounting face of pump housing. This distance should be 5-17/32 inches.

Use new gasket and reinstall pump by reversing removal procedure.

NOTE: In some cases, where overheating has become a problem, a belt pulley attachment such as that shown in Fig. 70 is available for Series B-275. The attachment consists of an additional pulley mounted on the injection pump gear cover which provides adjustment and a fixed diameter water pump pulley. In order to accommodate the attachment, a new injection pump gear cover is required and the crankcase breather pipe has been shortened and relocated.

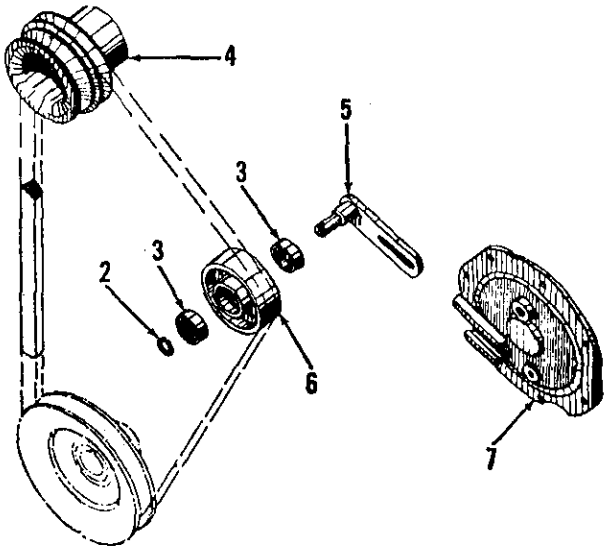


Fig. 70—View showing component parts which make up the fan belt adjusting pulley attachment for Series B-275.

2. Retainer
3. Bearings
4. Pulley hub
5. Bracket
6. Adjusting pulley
7. Injection pump gear cover

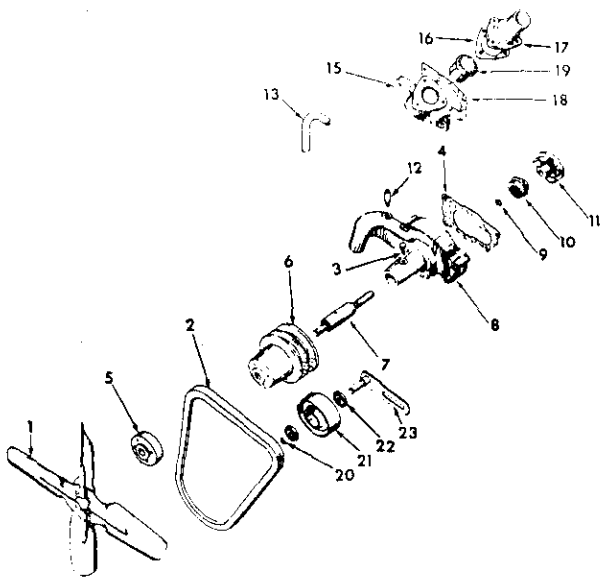


Fig. 71—Exploded view of the water pump used on Series 424, 444, 2424 and 2444 diesel tractors.

1. Fan blade
2. Fan belt
3. Set screw
4. Gasket
5. Spacer
6. Pulley
7. Shaft & bearing assy.
8. Pump body
9. "O" ring
10. Seal
11. Impeller
12. By-pass tube
13. By-pass hose
15. Thermostat housing
16. Gasket
17. Water outlet
18. Gasket
19. Thermostat
20. Snap ring
21. Belt adjuster pulley
22. Bearing
23. Bracket

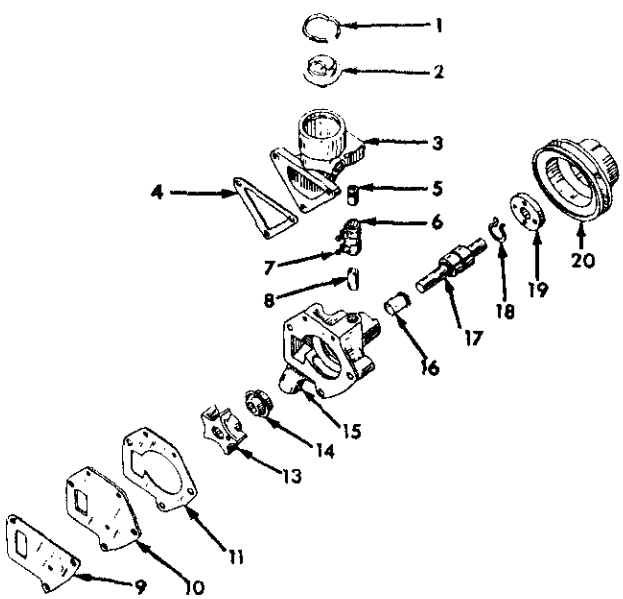


Fig. 72—Exploded view of the water pump used on Series 424, 444, 2424 and 2444 non-diesel tractors.

1. Retainer
2. Thermostat
3. Water outlet elbow
4. Gasket
5. Nipple
6. By-pass hose
7. Clamp
8. Nipple
9. Gasket
10. Plate
11. Gasket
13. Impeller
14. Seal
15. Pump body
16. Slinger
17. Shaft & bearing assy.
18. Snap ring
19. Hub
20. Pulley

Series 424-444-2424-2444 Diesel

133. **R&R AND OVERHAUL.** To remove the water pump, first drain cooling system, then remove hood and side panels. Loosen fan belt adjuster and generator or alternator belt adjuster and remove belts. Unbolt fan and lay same forward in shroud. Remove hoses then unbolt and lift out water pump.

To disassemble water pump, use a suitable puller and remove pulley (6—Fig. 71) from shaft (7). Remove set

screw (3), then press shaft, bearing, seal and impeller rearward out of pump body. Shaft can now be pressed from impeller.

The shaft and bearing (7) are available only as a pre-assembled unit. When renewing seal (10), press only on outer diameter. Both impeller and pulley hub must fit pump shaft with not less than 0.001 interference fit. Pump shaft bearing fit in housing is from 0.0003 loose to 0.0008 tight. After the seal and bearing and shaft unit are installed and set screw tightened, press impeller and pulley hub on pump shaft. Impeller must be pressed on flush with end of shaft. When pressing on pulley hub, be sure impeller end of shaft is supported. Do not subject pump housing to the pressing pressure.

Use new gasket and reinstall pump by reversing removal procedure.

Series 424-444-2424-2444 Non-Diesel

134. **R&R AND OVERHAUL.** To remove water pump, first drain cooling system, then remove hood skirts and side panels. Unbolt and remove the generator or alternator. Disconnect the lower hose and by-pass hose. Unbolt fan blades and pulley from water pump and let fan blades rest in shroud. Unbolt water pump from engine and withdraw pump from left side of tractor.

To disassemble pump, use a suitable puller and remove hub (19—Fig. 72) from shaft (17). Remove plate (10) and snap ring (18), then support pump body and press shaft and bearing assembly (17) from impeller (13) and pump body. Remove seal (14).

The shaft and bearing are available only as a pre-assembled and pre-lubricated unit. Water pump overhaul package (IH part No. 391028R92) is available from International Harvester Co. When renewing seal (14), press only on outer diameter.

Reassembly is evident, keeping in mind that vanes of impeller (13) and flange of hub (19) are toward front of tractor. Press impeller and hub on shaft until bottom of chamfer at each end shows. Clearance from face of body to face of impeller hub should be 0.031.

ELECTRICAL SYSTEM

Series B-275-B-414-354-364-384

135. Lucas generators, alternators, regulators and starting motors are used and the specifications are as follows:

Generator (B-275-B-414-354-364)

Model	C-39-P2
Brush spring tension (oz.)	22-25
Field resistance (ohms)	6.1
Output	
Hot or cold	Cold
Amperes	11.0
Volts	13.5
Rpm	1450-1700

Alternator (364-384)

Make	Lucas
Model	15ACR
Output	
Rpm	3000
Amperes	28

Regulator (B-275-B-414-354-364)

Model	RB108
Cut-out relay	
Air gap	0.025-0.040
Point gap	0.010-0.020
Closing voltage range	12.7-13.3
Voltage regulator,	
Air gap	See note
Setting (volts) range at 68°F	16.0-16.5
Ground polarity	Positive

NOTE: 0.015 for those with disc or wire winding core; 0.021 for those with square winding core.

Starting Motor (Series B-275-B-414-354-364-384 Diesel)

Model	M45G
Volts	12.0
Brush spring tension	30-40
No Load Test	
Volts	12.0
Amperes	70.0
Rpm	8000
Lock Test	
Volts	5.2
Amperes	930
Torque (Ft.-Lbs.)	29

Starting Motor (Series B-414-354 Non-Diesel)

Model	M418G
Volts	12.0
Brush spring tension (oz.)	30-40
No Load Test	
Volts	12.0

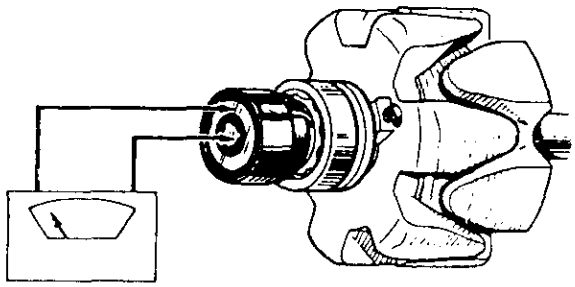


Fig. 73—Field winding continuity and resistance test. Refer to text.

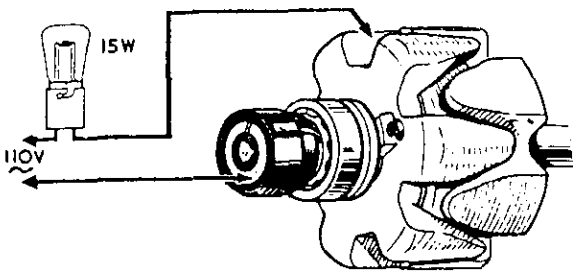


Fig. 74—Field winding insulation check. Refer to text.

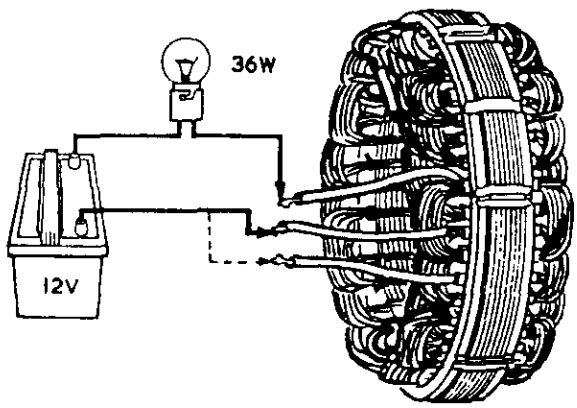


Fig. 75—Stator winding continuity test. Refer to text.

Amperes	45.0
Rpm	7400-8500
Lock Test	
Volts	7.0-7.4
Amperes	440-460
Torque (Ft.-Lbs.)	17

135A. ALTERNATOR AND REGULATOR. Late Series 364 and all Series 384 are equipped with Lucas alternators. The following component testing may be accomplished with minimum disassembly. See paragraph 135B for disassembly procedures.

Remove slip ring end cover. Note position of stator winding connections and unsolder connections from rectifier. Remove brush and regulator assembly. Renew brushes if overall length is less than 5/16-inches.

Check field winding continuity and resistance simultaneously by connecting a battery operated ohmmeter as shown in Fig. 73. The ohmmeter should read 4.3 ohms for 15 ACR rotor with pink winding or 3.3 ohms for 15 ACR rotor with purple winding.

To check field winding insulation, connect a 110 AC-15 watt test lamp as shown in Fig. 74. The lamp should not light.

Inner stator winding short-circuiting can be indicated by signs of burning of the insulation varnish covering. If this is obvious renew stator assembly. To check the continuity of the stator windings, connect any two of the three stator winding leads in series with a 12V battery and 36 watt test lamp (Fig. 75). Lamp should light. Transfer test lamp lead to third stator lead (Fig. 75). Lamp should light.

Check insulation of stator windings by connecting 110 AC-15 watt test lamp between lamination and any one of the three stator leads (Fig. 76). The lamp should not light.

To test the rectifier diodes connect a 12V battery and 1.5 watt bulb in series as shown in Fig. 77. Lamp should light during one-half of test only. If one diode is unsatisfactory renew rectifier assembly.

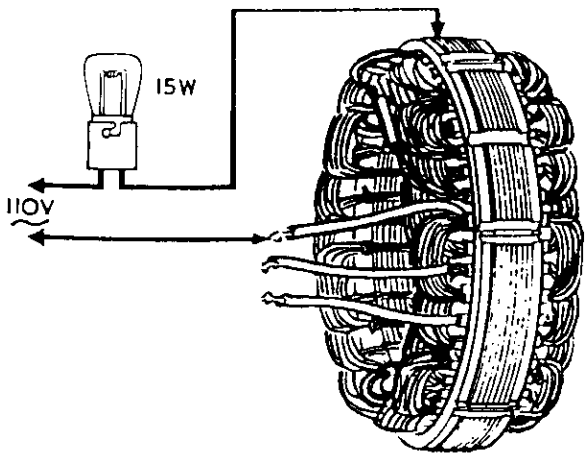


Fig. 76—Stator winding insulation check. Refer to text.

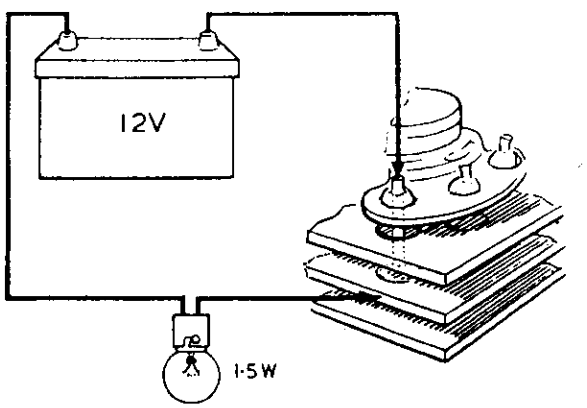


Fig. 77—Testing rectifier diodes. Refer to text.

135B. ALTERNATOR OVERHAUL. Refer to Fig. 78. Scribe a mark across

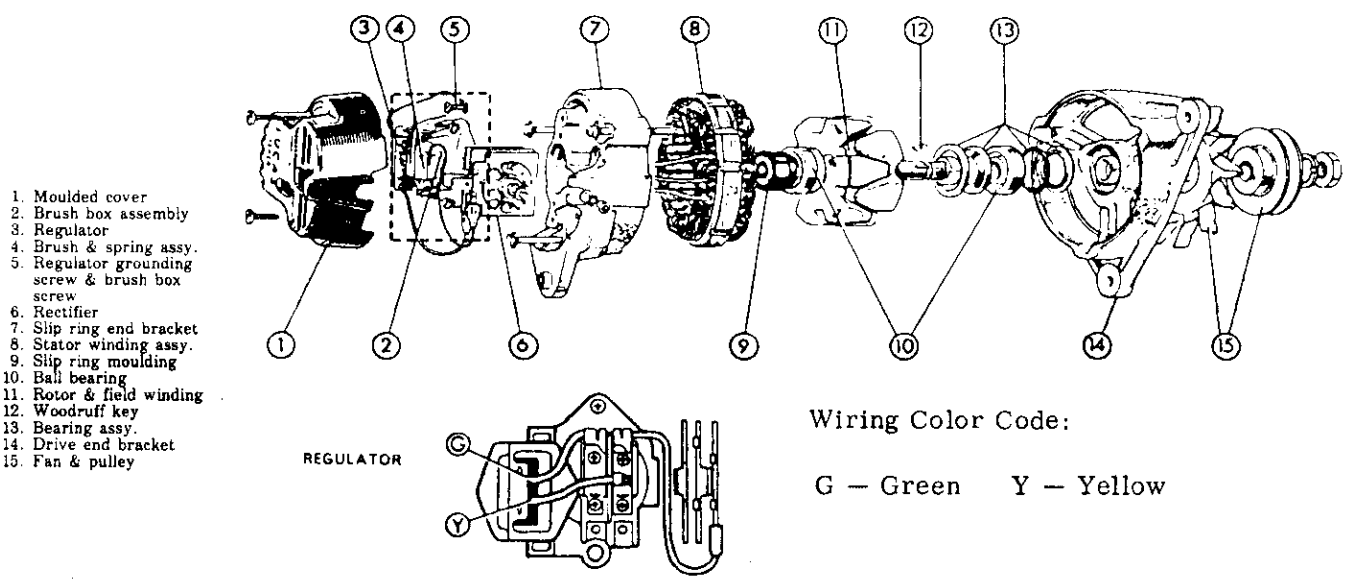


Fig. 78—Lucas alternator used on late Series 364 and all Series 384.

alternator halves. Remove mounting bolts and separate alternator. Separate stator from slip ring end bracket and rotor assembly from drive end bracket. Remove drive pulley, fan and shaft key. Then press rotor shaft from front bearing. Unsolder field winding connections and remove slip ring. Then press off rear bearing. To reassemble, reverse disassembly process. Use only "M" grade 45-55 resin-cored solder to attach stator wire to diode pins (Fig. 79). Torque alternator mounting bolts to 55 in.-lbs.

Series B-414 Non-Diesel

136. DISTRIBUTOR AND IGNITION TIMING. Lucas distributor is used and specifications are as follows:

Model	D3A4/LT
Breaker contact gap (in.)	0.014
Breaker arm spring pressure (oz.)	28-34
Advance Data*	
Start advance	5 at 500
Maximum advance	19.5 at 1100

*Advance data is in distributor degrees and rpm. Double the listed values for flywheel degrees and rpm.

Static timing should occur at 5 degrees BTDC. The rear flange of the crankshaft pulley is marked with a TDC mark (notch) and may or may not have an IGN. (5 degrees) mark (notch). If pulley does not have the IGN. mark, add such a mark 9/32-in. before the TDC mark.

NOTE: If advance timing is to be checked with a timing light, add an additional mark (notch) 2-7/32 inches ahead of the TDC mark at this time. This mark will indicate the 39 degrees BTDC advance timing specified for the engine.

To set static timing, proceed as follows: Check to see that distributor breaker points are in good condition and set at 0.014, then turn engine until number one piston is coming up on compression stroke. Continue to turn engine until the 5 degree mark on crankshaft pulley is aligned with timing pointer. Loosen distributor mounting, pull spark plug wire from number one spark plug and turn on ignition switch. Hold disconnected spark plug wire about 1/8-in. from a clean point on engine, then rotate distributor body clockwise until a spark jumps between the spark plug wire and engine. Tighten distributor mounting at this point.

NOTE: Always approach the number one cylinder firing position by rotating distributor body in the direction opposite to breaker cam rotation (clockwise). **If necessary, turn distributor body counter-clockwise past timing point, then set timing by turning distributor body clockwise.**

Turn ignition switch off and reinstall the number one spark plug wire.

If running timing is to be checked with a timing light, proceed as follows: Be sure the advance timing mark (2-7/32 in. before TDC) has been added to crankshaft pulley. Attach timing light, start engine and direct timing light at timing pointer. Timing pointer should be aligned with the advance timing mark (39 degrees) when engine is operating at high idle (2200 rpm).

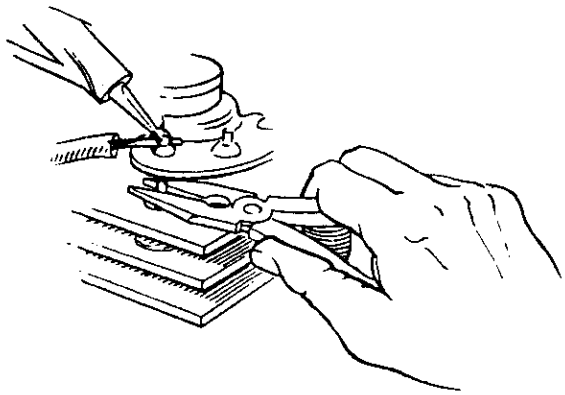


Fig. 79—Soldering stator wire to diode pins. Use long nose pliers as thermal shunt to avoid damage to diodes.

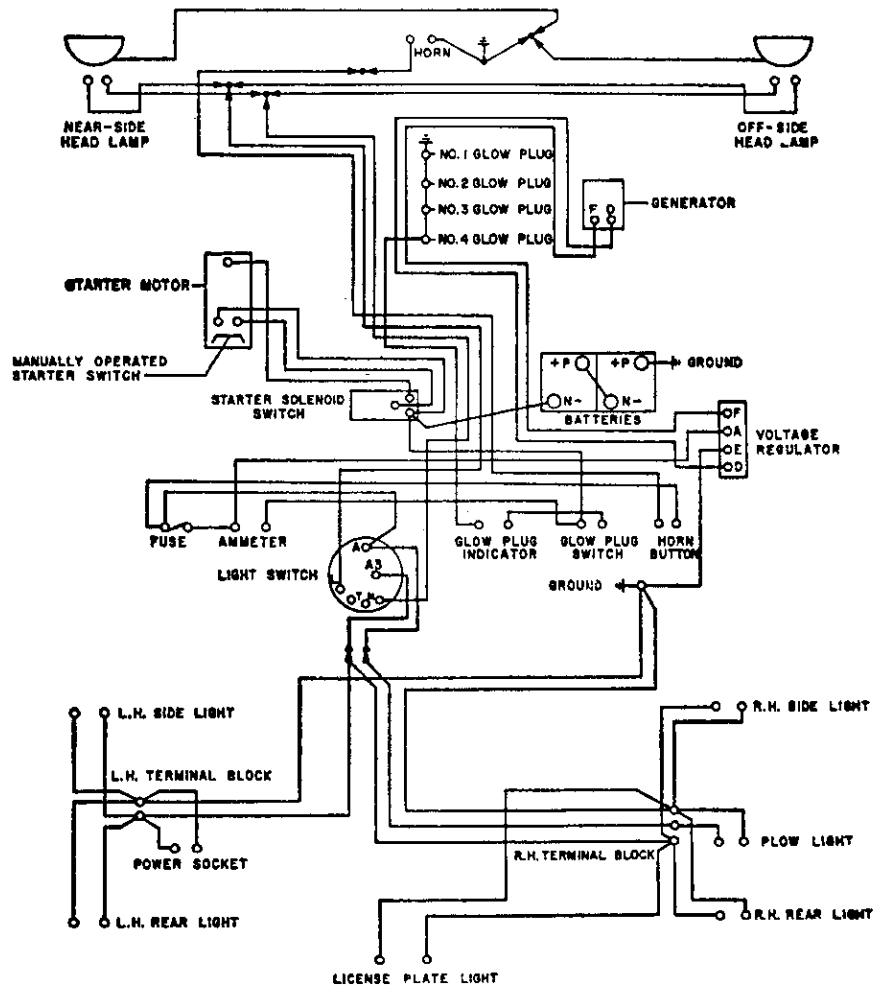


Fig. 80—Wiring diagram of the International B-275 tractor. Some of the units above may not be included.

Series 354 Non-Diesel

137. DISTRIBUTOR AND IGNITION TIMING. Model D204 Delco-Remy distributor is used and specifications are as follows:

Breaker contact gap (in.) 0.020
Breaker arm spring
pressure (oz.) 19-23
Cam dwell angle ..... 35°-37°
Advance Data*
Start advance ..... 1 at 300
Intermediate advance ..... 7.5 at 600
Maximum advance ..... 16.5 at 1100

*Advance data is in distributor degrees and rpm. Double the listed values for flywheel degrees and rpm.

To set static timing proceed as follows: Check to see that distributor breaker points are in good condition and set at .020. Turn engine until the notch in the crankshaft pulley is in line with the pointer on the timing cover. Remove the distributor cap and check that the points are just opening (0.003 maximum). If the points are not in this position loosen the mounting bolts and turn the distributor clockwise to open and counter-clockwise to close the points. Tighten the mounting bolts and install the distributor cap.

Slight advance or retard may be required to obtain smoothest operation. Turning the distributor clockwise will advance the timing and counter-clockwise will retard the timing.

Series 424-444-2424-2444

138. Delco-Remy electrical units are used and the specifications are as follows:

Generators 1100409 and 1100422
Brush spring tension (oz.) 28
Field draw:
Volts 12
Amperes 1.58-1.67
Cold output:
Volts 14
Amperes 25
Rpm 3040

Regulator 1119270E
Ground polarity ..... Negative
Cut-out relay:
Air gap 0.020
Point gap 0.020
Closing voltage, range 11.8-13.5
Adjust to 12.6

Voltage regulator:
Air gap 0.060
Voltage setting at degrees F.,
14.4-15.4 at 65°
14.2-15.2 at 85°
14.0-14.9 at 105°
13.8-14.7 at 125°
13.5-14.3 at 145°
13.1-13.9 at 165°

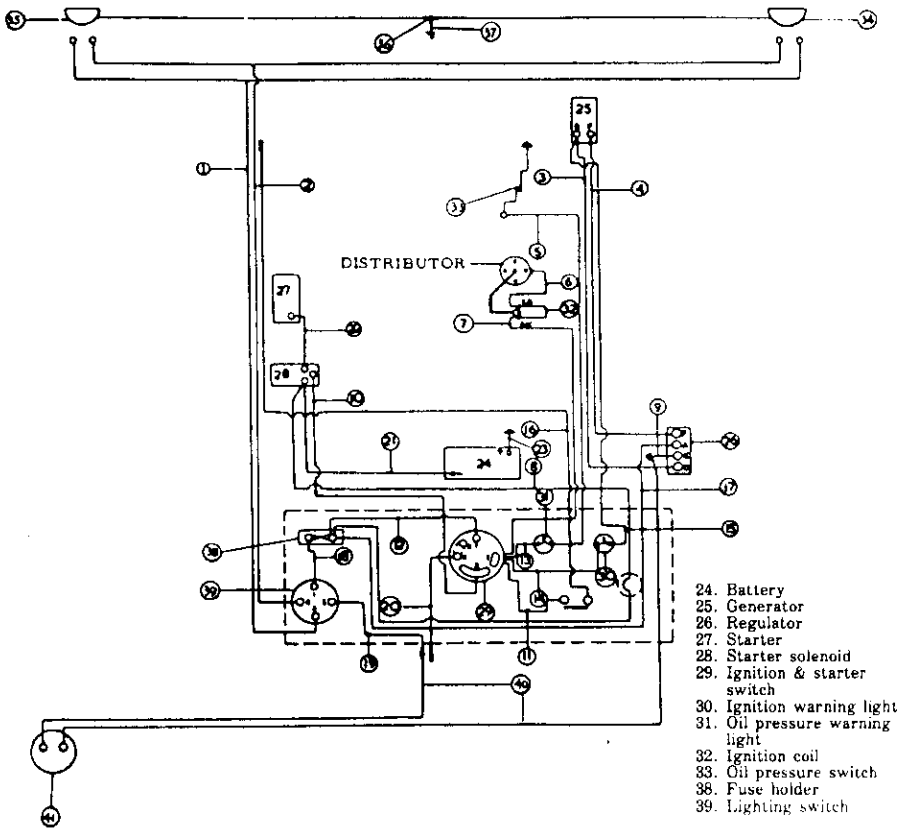


Fig. 81—Wiring diagram of Series B-414 non-diesel tractors.

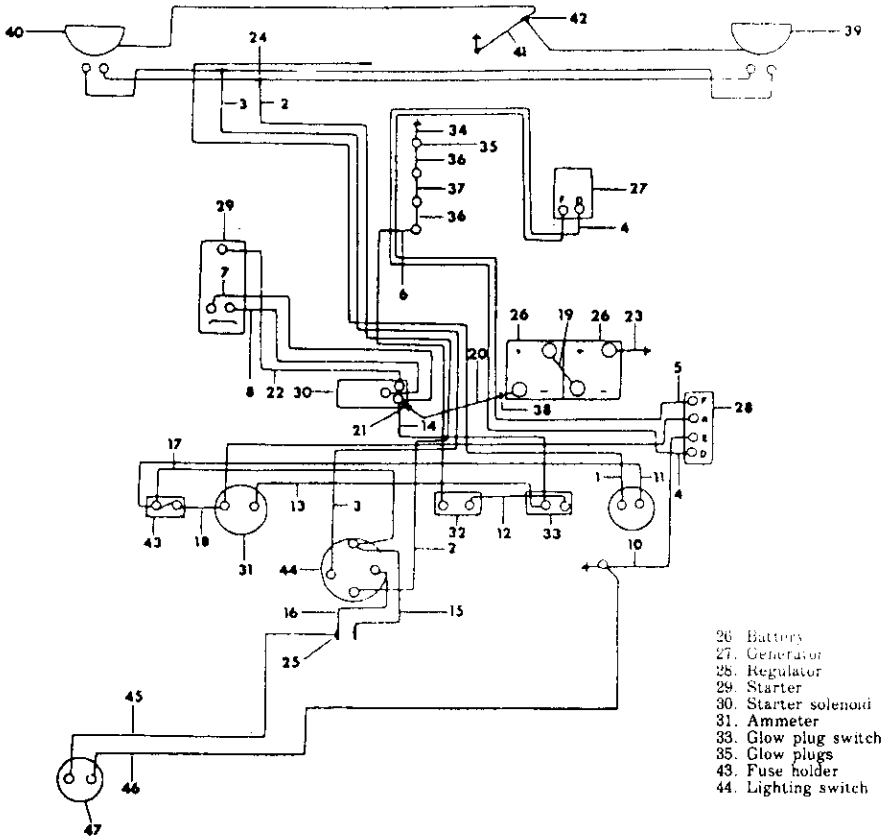


Fig. 82—Wiring diagram of Series B-414 diesel tractors. Ignition switch is not shown.

Current regulator:
- Air gap 0.075
- Current setting at degrees F.,
  - 25.0-30 at 65°
  - 24.5-29 at 85°
  - 23.5-28 at 105°
  - 23.0-27 at 125°
  - 21.5-25.5 at 145°
  - 20.5-24.5 at 165°
  - 19.5-23.5 at 185°

Starting Motors 1107364 and 1108323
- Volts 12
- Brush spring tension (oz.) 35
- No-load test:
  - Volts 9.0
  - Amperes (min.) 50*
  - Amperes (max.) 60*
  - Rpm (min.) 6000
  - Rpm (max.) 8500
- Resistance test:
  - Volts 4.3
  - Amperes (min.) 270
  - Amperes (max.) 310

*Includes solenoid.

Starting Motor 1107585
- Volts 12
- Brush spring tension (oz.) 35
- No-load test:
  - Volts 9.0
  - Amperes (min.) 50*
  - Amperes (max.) 80*
  - Rpm (min.) 5500
  - Rpm (max.) 9000
- Resistance test:
  - Volts 3.5
  - Amperes (min.) 330
  - Amperes (max.) 395

*Includes solenoid.

139. **ALTERNATOR AND REGULATOR.** Series 444 and 2444 are equipped with a "DELCOTRON" generator (alternator) and a double contact voltage regulator.

CAUTION: Because certain components of the alternator can be damaged by procedures that will not affect a D.C. generator, the following precautions MUST be observed:

a. When installing batteries or connecting a booster battery, the negative post of battery must be grounded.

b. Never short across any terminal of the alternator or regulator.

c. Do not attempt to polarize the alternator.

d. Disconnect all battery ground straps before removing or installing any electrical unit.

e. Do not operate alternator on an open circuit and be sure all leads are properly connected before starting engine.

Specification data for alternator and regulator are as follows:

Alternator 1100805
- Field current at 80° F,
  - Amperes 2.2-2.6
  - Volts 12.0
- Cold output at specified voltage,
  - Specified volts 14.0
  - Amperes at rpm ..... 21 at 2000
  - Amperes at rpm ..... 30 at 5000
- Rated output hot,
  - Amperes 32.0

Regulator 1119516
- Ground polarity ..... Negative
- Field relay,
  - Air gap 0.015
  - Point opening 0.030

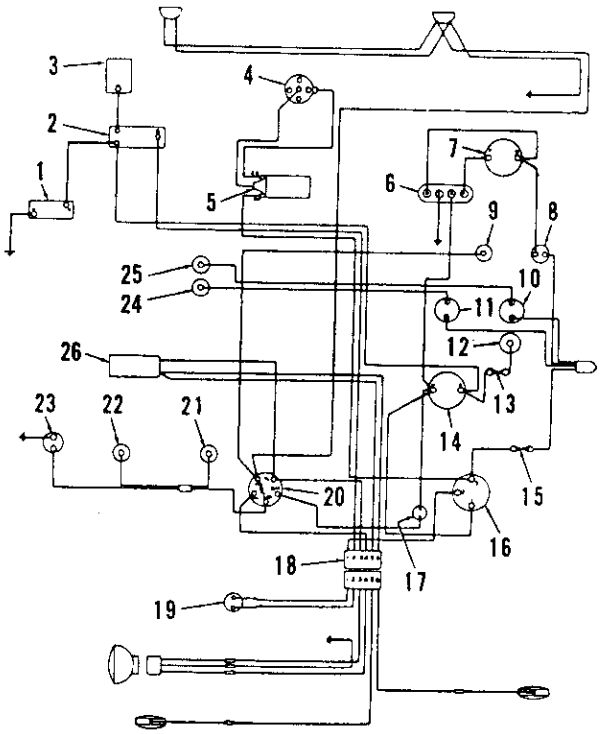


Fig. 83—Wiring diagram of Series 354 non-diesel tractors.

1. Battery
2. Solenoid
3. Starter
4. Distributor
5. Coil
6. Regulator
7. Generator
8. Generator warning light
9. Headlamp warning light
10. Heat indicator
11. Fuel gage
12. Lighter
13. In line fuse
14. Ammeter
15. In line fuse
16. Key switch
17. Fuse holder
18. Connector
19. Safety start switch
20. Light switch
21. Panel light
22. Panel light
23. Tractormeter light
24. Fuel sender
25. Heat sender
26. Flasher

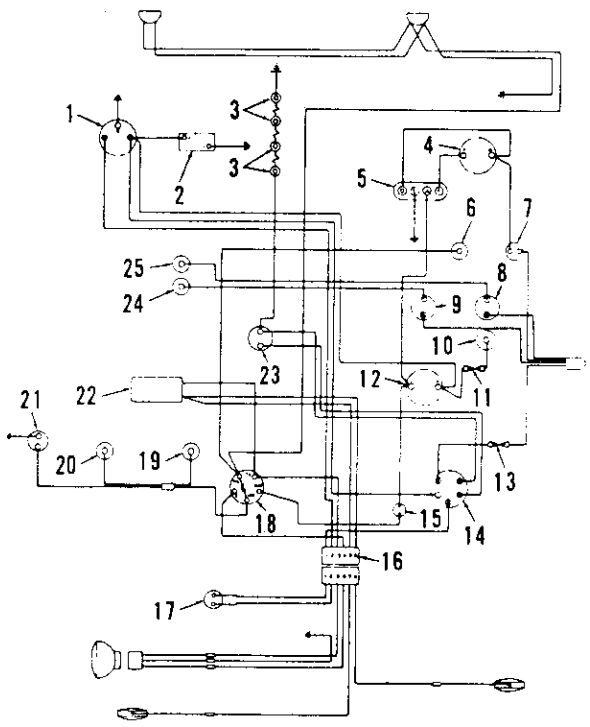


Fig. 84—Wiring diagram of Series 354 and 364 diesel tractors.

1. Starter
2. Battery
3. Glow plugs
4. Generator
5. Regulator
6. Headlamp warning light
7. Generator warning light
8. Heat indicator
9. Fuel gage
10. Lighter
11. In line fuse
12. Ammeter
13. In line fuse
14. Key switch
15. Fuse holder
16. Connector
17. Safety start switch
18. Light switch
19. Panel light
20. Panel light
21. Tractormeter light
22. Flasher
23. Flow plug indicator
24. Fuel sender
25. Heat sender

Closing voltage range 1.5-3.2
Voltage regulator,
Air gap (lower points closed) 0.067 (1)
Upper point opening (lower points closed) 0.014
Voltage setting at degrees F,
13.9-15.0 at 65°
13.8-14.8 at 85°
13.7-14.6 at 105°
13.5-14.4 at 125°
13.4-14.2 at 145°
13.2-14.0 at 165°
13.1-13.9 at 185°

(1) When bench tested, set air gap at 0.067 as a starting point, then adjust air gap to obtain specified difference between voltage settings of upper and lower contacts. Operation on lower contacts must be 0.05-0.4 volt lower than on upper contacts. Voltage setting may be increased up to 0.3 volt to correct chronic battery under-charging or decreased up to 0.3 volt to correct battery over-charging. Temperature (ambient) is measured ¼-inch away from regulator cover and adjustment should be made only when regulator is at normal operating temperature.

140. ALTERNATOR TESTING AND OVERHAUL. The only test which can be made without removal and disassembly of alternator is output test. Output should be approximately 32 amperes at 5000 alternator rpm.

To disassemble the alternator, first place match marks (M—Fig. 85) on the two frame halves (6 and 16), then remove the four through-bolts. Pry frame apart with a screwdriver between stator frame (11) and drive end frame (6). Stator assembly (11) must remain with slip ring end frame (16) when unit is separated.

NOTE: When frames are separated, brushes will contact rotor shaft at bearing area. Brushes MUST be cleaned of lubricant if they are to be re-used.

Clamp the iron rotor (12) in a protected vise only tight enough to permit loosening of pulley nut (1). Rotor and end frame can be separated after pulley is removed. Check bearing surfaces of rotor shaft for visible wear or scoring. Examine slip ring surfaces for scoring or wear and windings for overheating or other damage. Check rotor for grounded, shorted or open circuits using an ohmmeter as follows:

Refer to Fig. 86 and touch the ohmmeter probes to points (1-2 and 1-3); a reading near zero will indicate a ground. Touch ohmmeter probes to the two slip rings (2-3); reading should be 4.6-5.5 ohms. A higher reading will indicate an open circuit and a lower reading will indicate a short. If windings are satisfactory, mount rotor in a lathe and check runout at slip rings using a dial indicator. Runout should not exceed 0.002. Slip ring surfaces can be trued if runout is excessive or if surfaces are scored. Finish with 400 grit or finer polishing cloth until scratches or machine marks are removed.

Disconnect the three stator leads and separate stator assembly (11—Fig. 85) from slip ring end frame assembly. Check stator windings for grounded or open circuits as follows: Connect ohmmeter leads successively between each pair of stator leads. A high reading would indicate an open circuit.

NOTE: The three stator leads have a common connection in the center of the windings. Connect ohmmeter leads between each stator lead and stator frame. A very low reading would indicate a grounded circuit. A short circuit within the stator windings cannot be readily determined by test because of the low resistance of the windings.

Three negative diodes (19) are located in the slip ring end frame (16) and three positive diodes (20) in heat sink (15). Diode should test at or near infinity in one direction when tested with an ohmmeter, and at or near zero when meter leads are reversed. Renew any diode with approximately equal meter readings in both directions. Diodes must be removed and installed using an arbor press or vise and suitable tool which contacts only the outer edge of the diode. Do not attempt to drive a faulty diode out of end frame or heat sink as shock may cause damage to the other good diodes. If all diodes are being renewed, make certain the positive diodes (marked with red printing) are installed in the heat sink and negative diodes (marked with black printing) are installed in the end frame.

Brushes are available only in an assembly which includes brush holder (13). Brush springs are available for service and should be renewed if heat damage or corrosion is evident. If brushes are reused, make sure all grease is removed from surface of brushes before unit is reassembled. When reassembling, install brush springs and brushes in holder, push brushes up against spring pressure and

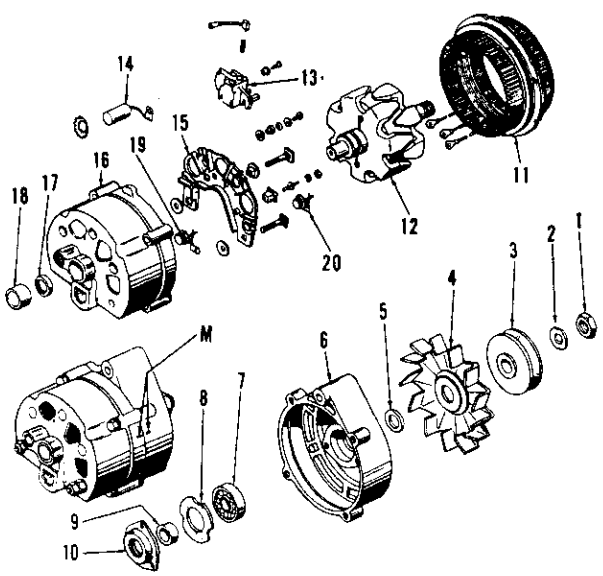


Fig. 85—Exploded view of "DELCOTRON" alternator used on Series 444 and 2444.

1. Pulley nut
2. Washer
3. Drive pulley
4. Fan
5. Spacer
6. Drive end frame
7. Ball bearing
8. Gasket
9. Spacer
10. Bearing retainer
11. Stator assembly
12. Rotor assembly
13. Brush holder
14. Capacitor
15. Heat sink
16. Slip ring end frame
17. Felt seal & retainer
18. Needle bearing
19. Negative diode (3 used)
20. Positive diode (3 used)

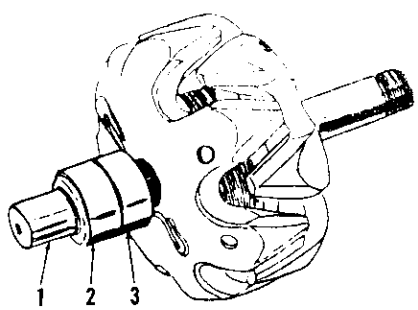


Fig. 86—Removed rotor assembly showing test points when checking for grounds, shorts and opens.

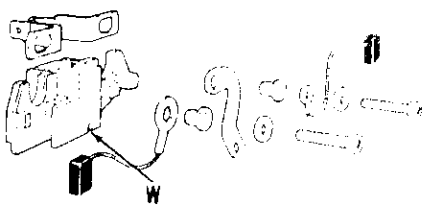


Fig. 87—Exploded view of brush holder assembly. Insert wire in hole (W) to hold brushes up. Refer to text.

insert a short piece of straight wire through hole (W—Fig. 87) and through end frame (16—Fig. 85) to outside. Withdraw the wire only after alternator is assembled.

Capacitor (14) connects to the heat sink and is grounded to the end frame. Capacitor protects the diodes from voltage surges.

Remove and inspect ball bearing (7). If bearing is in satisfactory condition, fill bearing ¼-full with Delco-Remy lubricant No. 1960373 and reinstall. Inspect needle bearing (18) in slip ring end frame. This bearing should be renewed if its lubricant supply is exhausted; no attempt should be made to relubricate and reuse the bearing.

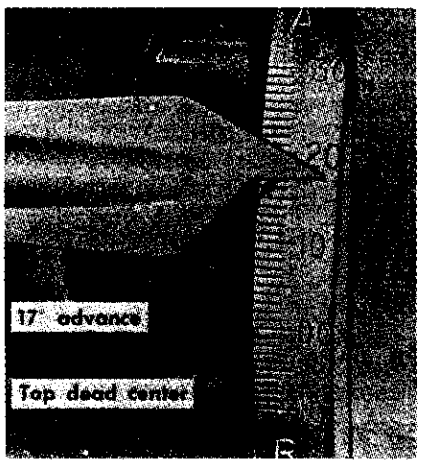


Fig. 88—View showing timing marks on Series 424, 444, 2424 and 2444 non-diesel engine.

Press old bearing out towards inside and press new bearing in from outside until bearing is flush with outside of end frame. Saturate felt seal with SAE 20 oil and install seal and retainer assembly.

Reassemble alternator by reversing the disassembly procedure. Tighten pulley nut to a torque of 45 ft.-lbs.

NOTE: A battery powered test light can be used instead of ohmmeter for all electrical checks except shorts in rotor winding. However, when checking diodes, test light must not be of more than 12 volts.

141. **DISTRIBUTOR.** Identification and tune-up data for the Series 424, 444, 2424 and 2444 distributor is as follows:

Make	IH
Identification symbol	AK
Breaker contact gap	0.020
Breaker arm spring pressure	21-25 oz.
Advance Data (degrees at flywheel rpm)	
Start advance	0 at 375
Maximum advance	17 at 2200

142. IGNITION TIMING. If the distributor has been removed for service, reinstall same as follows: Crank engine until No. 1 (front) piston is coming up on compression stroke and continue cranking slowly until TDC (0 degree) mark on crankshaft pulley is aligned with the pointer extending from front face of the timing gear cover. Turn distributor shaft until rotor arm is in the No. 1 firing position and install distributor.

To set static timing, proceed as follows: Make certain that distributor breaker points are in good condition and set at 0.020. Loosen the distributor mounting cap screws and retard distributor about 30 degrees by turning distributor assembly in same direction as breaker cam rotates. Turn engine until No. 1 piston is coming up on compression stroke, then continue cranking slowly until TDC mark on crankshaft pulley is in register with the timing pointer. Disconnect coil secondary wire from distributor cap and hold free end of cable 1/16 to 1/8 inch from distributor primary terminal. Advance the distributor by turning distributor body in opposite direction from breaker cam rotation until a spark occurs between cable and primary terminal. Tighten distributor mounting cap screws at this point. Assemble spark plug cables to the distributor cap in the proper firing order of 1-3-4-2.

To set running timing, attach a timing light and start engine. Adjust engine low idle speed to 375 rpm. At this time, the timing light should show the TDC mark in register with the timing pointer. Then with engine speed set at 2200 rpm check to see that the 17 degree advance mark is aligned with timing pointer as shown in Fig. 88. After the preceding checks and adjustments have been made, readjust engine low idle speed to 425 rpm.

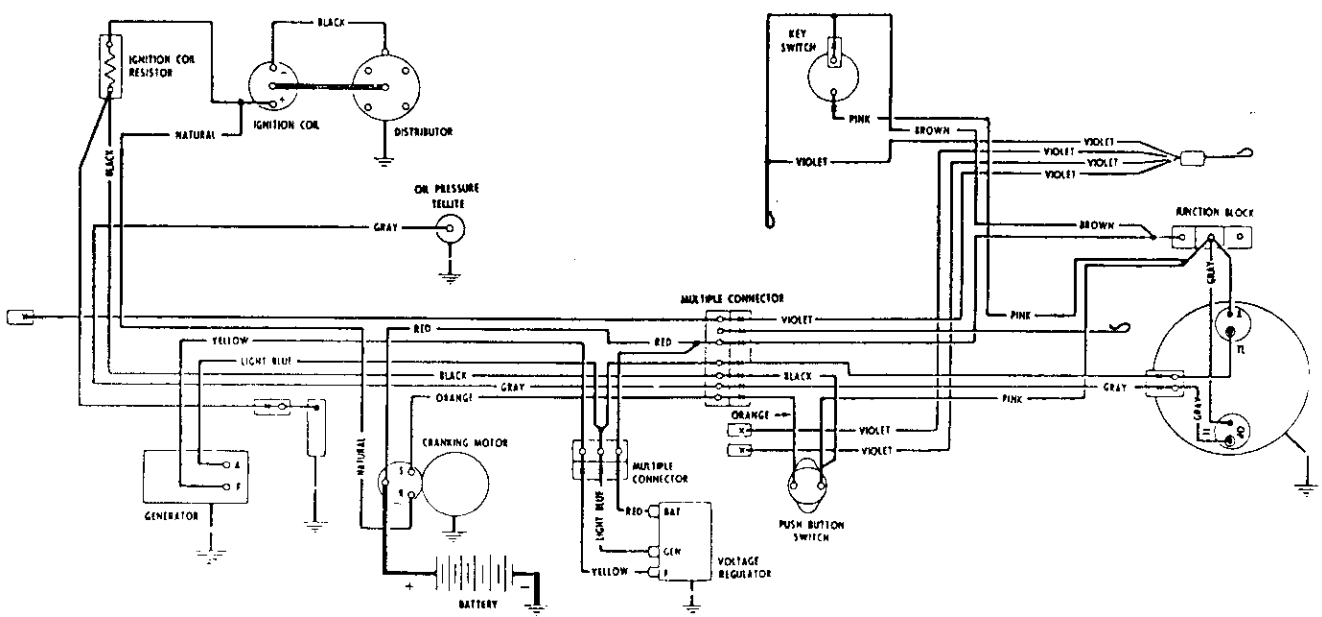


Fig. 89—Wiring diagram of Series 424 and 2424 non-diesel tractors.

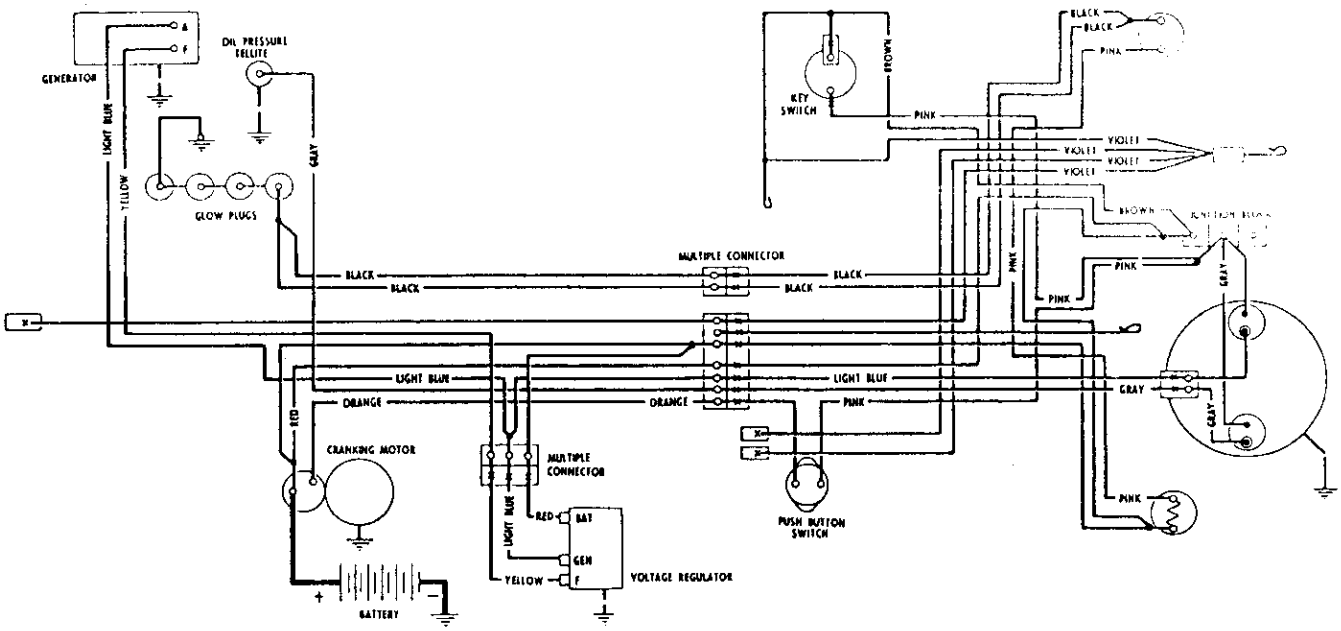


Fig. 90—Wiring diagram of Series 424 and 2424 diesel tractors.

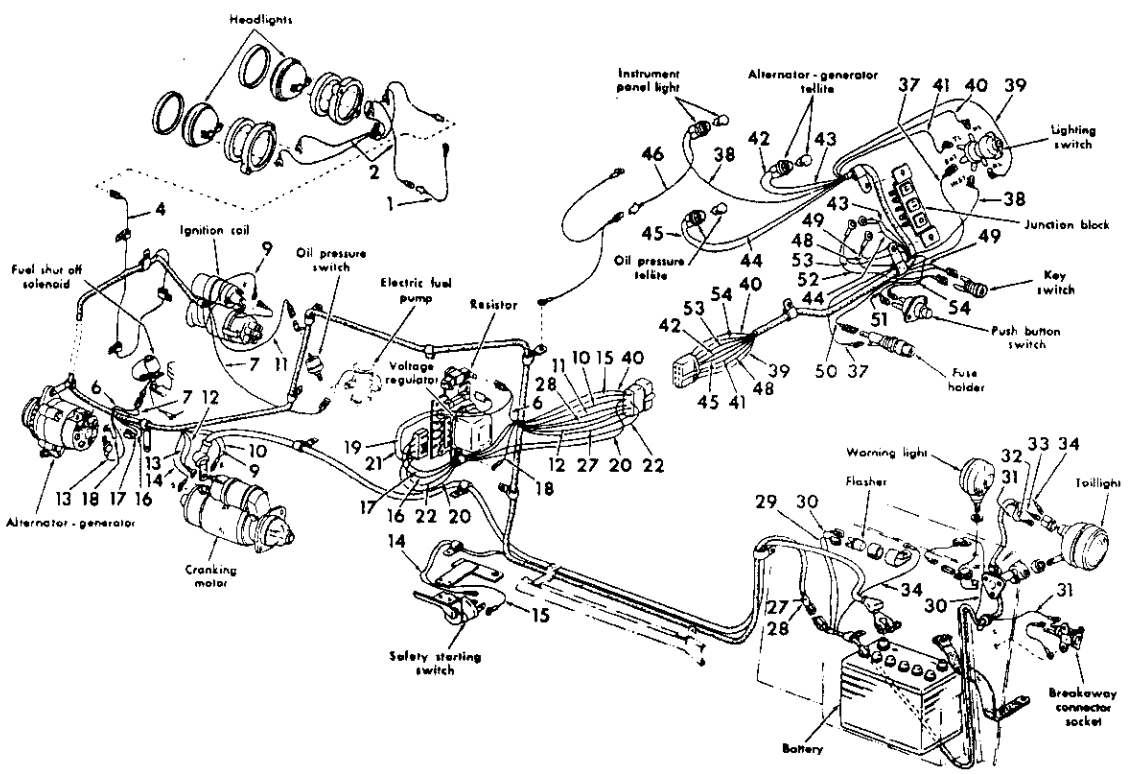


Fig. 91—Wiring and electrical components used on Series 444 and 2444 non-diesel tractors.

1. Pink
2. Red
4. Violet
6. Light green
7. Light green w/black tracers
9. White
10. Natural w/orange & purple tracers
11. Gray
12. Red
13. Light blue
14. Orange w/black tracers
15. Orange
16. Yellow
17. Brown
18. Pink
19. Light green
20. Light green
21. Light blue
22. Light blue
27. White w/black tracers
28. Black
29. Black
30. Brown
31. Black w/white tracers
32. Black
33. White
34. Pink
37. Light green
38. Tan
39. White
40. Violet
41. Black w/white tracers
42. Light blue
43. White w/black tracers
44. Black w/white tracers
45. Gray
46. Pink
48. Red
49. Red
50. Red
51. Light green
52. Light green
53. Light green
54. Orange

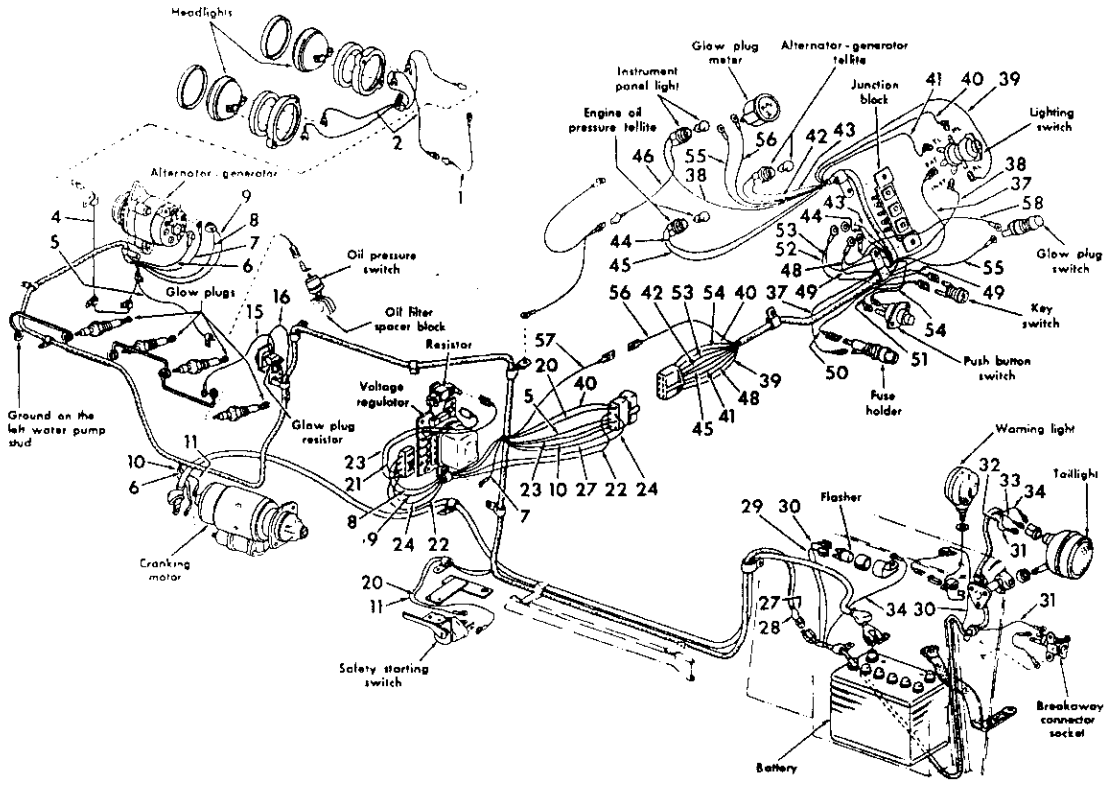


Fig. 92—Wiring and electrical components used on Series 444 and 2444 diesel tractors.

1. Pink
2. Red
4. Violet
5. Gray
6. Light blue
7. Pink
8. Brown
9. Yellow
10. Red
11. Orange w/black tracers
16. Black
20. Orange
21. Light green
22. Light green
23. Light blue
24. Light blue
27. White w/black tracers
28. Black
29. Black
30. Brown
31. Black w/white tracers
32. Black
33. White
34. Pink
37. Light green
38. Tan
39. White
40. Violet
41. Black w/white tracers
42. Light blue
43. White w/black tracers
44. Black w/white tracers
45. Gray
46. Pink
48. Red
49. Red
50. Red
51. Light green
52. Light green
53. Light green
54. Orange
55. Pink
56. Black
57. Black
58. Red

CLUTCH

Series B-275-B-414-354-364-384

143. Tractor may be equipped with a single plate or a dual plate clutch. Series B-414, 364 and 384 have an 11-inch single plate clutch and Series 354 has a standard 10-inch or optional 11-inch heavy duty single plate clutch. All models are available with the dual plate clutch which has an 11-inch main driven member with a 9-inch pto driven member.

144. **ADJUST.** Adjustment to compensate for lining wear is accomplished by adjusting the clutch pedal height and free travel.

To adjust clutch pedal height, position clutch pedal by turning adjusting screw (S—Fig. 93) until bottom of clutch pedal measures 6-7/8 inches from foot plate for Series B-275, B-414, 354, 364 and 384 tractors equipped with dual plate clutch. With single plate clutch, the measurement should be 5-13/16 inches for Series B-414, 7 inches on 364 and 384 and 7 inches for 10 inch clutch or 4-9/16 inches for 11 inch clutch used on Series 354. The pedal free travel of ¾-inch (dual plate clutch) and 1-7/8 inch on 11 inch or 7/8-inch on 10 inch (single plate clutch) is obtained by loosening retaining bolts (B—Fig. 93) and moving pedal around clutch cross-shaft. Clutch cross-shaft may be held by using a wrench on flats of cross-shaft outer end.

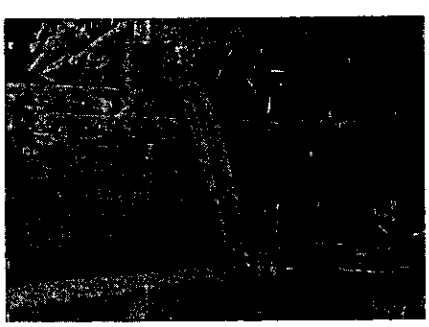


Fig. 93—Clutch pedal of B-275, B-414, 354, 364 or 384 tractor with dual plate clutch. Refer to text for adjustment procedure and note that on Series B-414 with single plate clutch, pedal height is adjusted to 5-13/16 inches. On Series 354, pedal height is 7 inches for 10-inch single plate clutch or 4-9/16 inches for 11-inch single plate clutch. Pedal height on 364 and 384 with single plate 11-inch clutch is 7 inches.

145. **REMOVE AND REINSTALL.** The procedure for removing and reinstalling the clutch is evident after splitting the engine from the clutch housing as outlined in the following paragraph.

146. TRACTOR SPLIT. To separate engine from clutch housing, first raise or remove hood. On Series B-275 and B-414, remove battery shield, battery hold-down and battery, or batteries. Remove battery tray and throttle bellcrank. On all series, if tractor is equipped with a down swept exhaust, disconnect exhaust pipe at manifold.

then remove exhaust pipe and muffler. Disconnect wires from alternator or generator, starter switch and ignition coil (non-diesel models), or number four glow plug (diesel models). Disconnect battery cable from starter and operating rod from starter switch. On diesel models, disconnect fuel shut-off rod at injection pump and remove rod. On non-diesel models, disconnect choke control from carburetor. Close fuel shut-off valve and disconnect fuel supply line from fuel pump. On diesel models, disconnect fuel return line from fuel tank. On all models, disconnect oil pressure gage line from cylinder block. On Series B-275 and B-414, drain cooling system and remove temperature sending unit from cylinder head. On Series 354, 364 and 384 disconnect temperature gage wire and tachometer cable. On all series, disconnect the pressure and inlet lines from hydraulic pump. Disconnect drag link from steering gear drop arm on manual steering models; or on models with power steering, disconnect hoses from power steering cylinder, cylinder from reaction bracket and drag link from steering gear drop arm. Support clutch housing, attach hoist to engine, then unbolt and separate engine from clutch housing.

NOTE: When rejoining engine to clutch housing, time can often be saved, particularly on dual plate clutch models, if the following procedure is used. Place clutch assembly on input shafts (Fig. 94), then move sections together until transmission input shaft pilot enters pilot bearing and flywheel butts against clutch cover. Now bolt clutch to flywheel and complete the mating of engine and clutch housing by pulling sections together with the retaining cap screws.

147. **OVERHAUL (DUAL PLATE).** With tractor split as outlined in paragraph 146, proceed as follows: Remove the cap screws retaining the clutch cover assembly to flywheel and withdraw the cover assembly and 11-inch lined disc. Examine the clutch shaft pilot bearing in crankshaft and renew the bearing if same is damaged or worn.

To disassemble the clutch cover assembly, proceed as follows: Carefully place punch marks on all of the components so they can be reassembled in the same relative position. Place the assembly in a press with the cover assembly up. Place a bar across the cover and compress the assembly until the release levers are just free. Loosen the locknuts and completely unscrew the finger adjusting screws (41—Fig. 95). Release the compressing pressure and disassemble the remaining parts.

Inspect all parts and renew those showing damage or wear. New facings can be riveted to the driven discs if discs are otherwise in good condition.

To reassemble the unit, refer to Fig. 95 and proceed as follows:

NOTE: It is important that a new 11-inch disc be used during adjustment of clutch fingers and pto adjustment screws. The original 11-inch disc can be reinstalled after adjustment is complete providing it is in serviceable condition.

Place the 11-inch pressure plate (32) on work bench with friction face down. Install the red marked Belleville washer (35) on pressure plate with convex side up and outer edge in counterbore of pressure plate. Align the previously affixed punch marks and install flywheel plate (36). Position the 9-inch driven disc (24) on flywheel plate with hub of same upward; then, again aligning punch marks, install the 9-inch pressure plate (37). Install second (blue marked) Belleville washer (35) on pressure plate (37) with concave side up. Align punch marks and place clutch bracket (cover) (38) in position, using caution to see that outer edge of Belleville washer is in counterbore of bracket (cover) (38). To facilitate starting of clutch finger adjusting screws, drop three cap screws through bracket (38) and flywheel plate (36), equidistant around outer bolt circle. Start clutch finger adjusting screws (41) and tighten only enough to hold clutch parts in position.

Install a NEW 11-inch driven disc in counterbore of flywheel, with hub pointing away from engine. Position clutch assembly on flywheel and start the retaining cap screws. Install aligning tool (pilot) and tighten cap screws. See Fig. 96.

To adjust clutch, refer to Fig. 97 for tools required and proceed as follows: With clutch finger height gage in position as shown in Fig. 98 or 98A and while holding slightly on finger to take out the slack, turn finger adjusting screw until the 2-21/32 inches dimension for Series B-275 and B-414 is

Fig. 96—Using aligning tool when installing dual plate clutch assembly to flywheel.

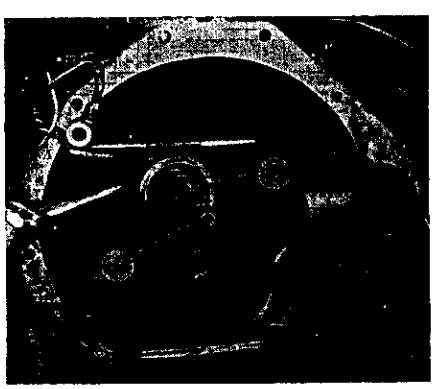
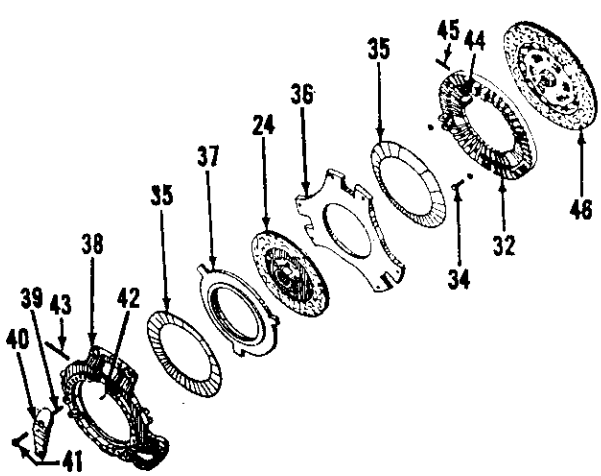


Fig. 94—Two concentric shafts are used when tractors are equipped with dual plate clutches. Outer shaft (2) drives pto, inner shaft (1) drives transmission.

Fig. 95—Exploded view of Series B-275, B-414, 354, 364 and 384 dual clutch and related parts.

24. 9" driven disc
32. 11" pressure plate
34. Cap screw (special)
35. Belleville washer
36. Flywheel plate
37. 9" pressure plate
38. Bracket (cover)
39. Spring
40. Release lever
41. Adjusting screw
42. Lock pin
43. Pivot pin
44. Rod end
45. Pin
46. 11" driven disc



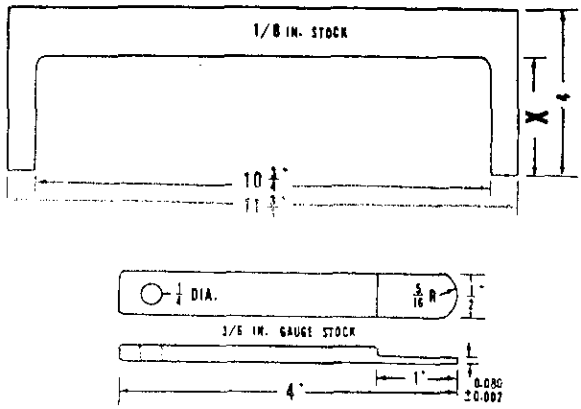


Fig. 97—Tools used to adjust the dual plate clutch. Tools can be made locally, using the dimensions shown. Dimension "X" is 2-21/32 inches for Series B-275 and B-414 and 2-25/32 inches for Series 424, 444, 2424, 2444, 354, 364 and 384.

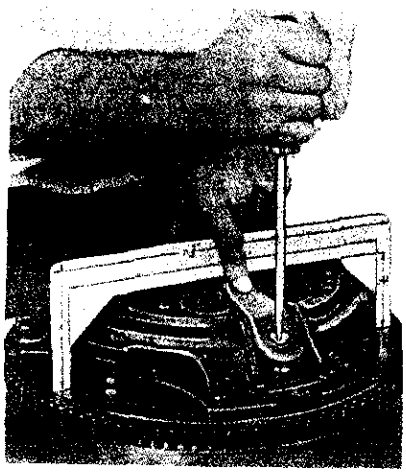


Fig. 98—Using special tool to adjust the dual plate clutch release lever height. Adjustment must be made with a NEW 11-inch driven disc installed.

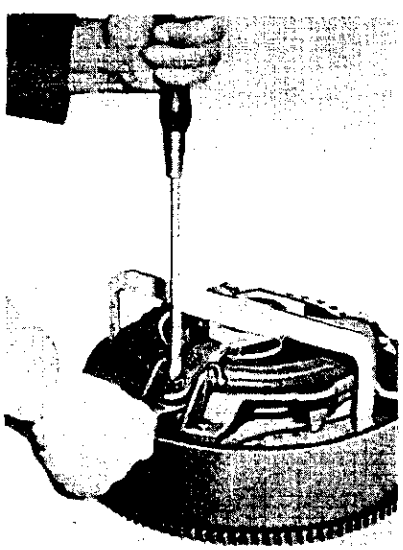


Fig. 98A—Using special tool to adjust the dual plate clutch release lever height on 354, 364 and 384. Adjustment must be made with a NEW 11-inch driver disc and RELEASE LEVER PLATE installed.

obtained. On Series 354, 364 and 384, adjustment is 2-25/32 inches, measured with release lever plate installed. See Fig. 98A. When adjustments are obtained, tighten locknut, repeat same procedure on other fingers. It is IMPORTANT that clutch fingers be adjusted to within 0.015 of each other. Use a box end wrench, or similar tool, and actuate each finger through its normal range of travel several times and recheck adjustment.

With finger adjustment made, refer to Fig. 99 and set the clearance between the 9-inch pressure plate and adjusting cap screws. Loosen locknuts and turn adjusting screw until the 0.080 thickness gage can just be inserted between head of adjusting screw and 9-in. pressure plate. Tighten locknuts.

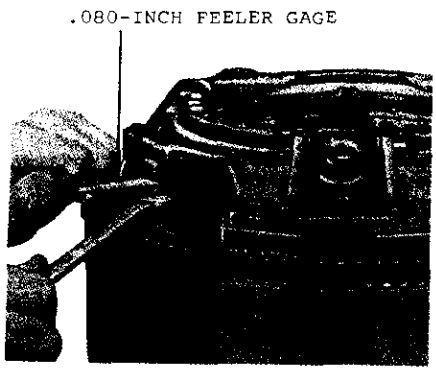


Fig. 99—Using special tool to adjust the 0.080 clearance between the 9-inch pressure plate and the releasing cap screws.

148. **OVERHAUL (SINGLE PLATE).** With tractor split as outlined in paragraph 146, refer to Fig. 100 and proceed as follows: Unbolt and remove cover assembly from flywheel. Disengage release lever plate retainers and remove release lever plate. Place clutch assembly in a press and apply pressure until release levers are relieved of tension. Remove release lever pins, then release press pressure and separate clutch assembly. Further disassembly is obvious.

Component parts of clutch assembly are catalogued separately, and in addition, a facing package for the driven disc is available for service.

Clutch pressure springs should have a free length of 2.68 inches and should test 120-130 lbs. when compressed to a length of 1.69 inches. Adjust clutch release fingers to a height of 1.955 inches, measured from contacting surface of fingers to friction face of pressure plate.

Series 424-444-2424-2444

149. Tractors may be equipped with a 11-inch single plate clutch or a dual plate clutch with a 11-inch main driven member and a 9-inch pto driven member. The single plate clutch is used in tractors equipped with transmission driven pto and the dual stage clutch is used in tractors equipped with a continuous running pto.

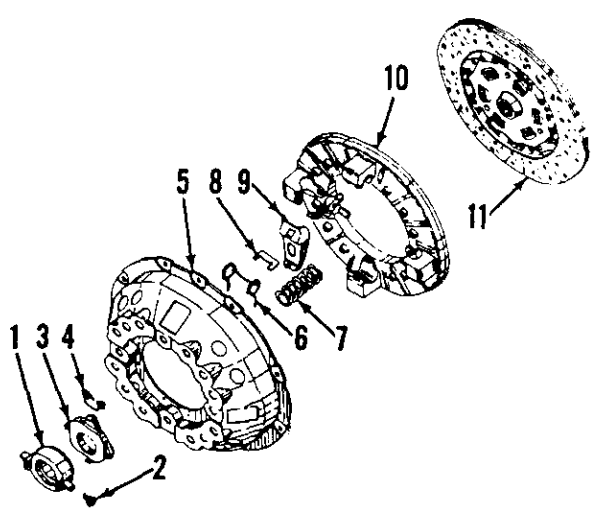


Fig. 100—Exploded view of the single plate clutch used on B-414, 354, 364 and 384 tractors without constant running pto.

1. Release bearing & cup
2. Retainer spring
3. Lever plate
4. Retainer spring
5. Clutch cover
6. Anti-rattle spring
7. Clutch spring
8. Strut
9. Release lever
10. Pressure plate
11. Clutch plate

150. **ADJUST.** Adjustment to compensate for lining wear is accomplished by adjusting the clutch pedal. First, adjust set screw shown in Fig. 101 until pedal height is 6 inches (measured from the foot rest to highest point on pedal flange). Then, loosen pedal clamp bolts and rotate the clutch pedal on clutch release shaft until ¾-inch free travel is obtained. Clutch cross-shaft may be held by using a wrench on flats of cross-shaft outer end. Tighten the pedal clamp bolts securely.

151. **REMOVE AND REINSTALL.** The procedure for removing the clutch is evident after splitting the engine from the clutch housing as outlined in the following paragraph.

152. TRACTOR SPLIT. To separate the engine from clutch housing, first remove hood and drain cooling system. Disconnect battery cables and wiring harness multiple plug under instrument panel, then work harness forward until it is clear of clutch housing.

On tractors equipped with mechanical steering, unbolt the steering shaft front and rear bearing brackets from the fuel tank support and clutch housing. Slide steering shaft forward and out of the master splined yoke.

On tractors equipped with power steering, remove the steering tube clip from engine and disconnect the tubes from the power steering control valve. Plug and cap all openings to prevent dirt from entering steering system.

Then, on all tractors, disconnect the fuel supply line, choke cable or fuel shut-off cable, engine speed control rod and tachometer cable. Remove the temperature indicator bulb and disconnect battery cable from the cranking motor solenoid switch. Unbolt and remove the cranking motor. Unbolt the air cleaner bracket from fuel tank support, place a wood block between fuel tank and clutch housing and then, unbolt the fuel tank support from engine. Remove the underslung exhaust pipe, if so equipped.

Drain the hydraulic system and disconnect the hydraulic pump pressure and suction lines. Plug and cap all openings.

On diesel models, remove the clutch housing front dust cover.

Then, on all tractors, unbolt stay-rod bracket from clutch housing and place wood blocks between steering gear housing and front axle to prevent tipping. Support clutch housing, attach a hoist to engine, then unbolt and separate engine from clutch housing. Unbolt and remove clutch from flywheel.

When rejoining engine to clutch housing, place clutch assembly on the pto driving shaft (two stage clutch) and transmission input shaft. Bolt engine to clutch housing, then working through the opening in bottom of clutch housing, bolt clutch assembly to flywheel.

153. **OVERHAUL (DUAL PLATE).** With tractor split as outlined in paragraph 152, proceed as follows: Remove cap screws retaining the clutch assembly to flywheel and withdraw the cover assembly and 11-inch lined disc. Examine the clutch shaft pilot bearing in flywheel and renew the bearing if same is damaged or worn.

To disassemble the clutch cover assembly, proceed as follows: Carefully place punch marks on all of the components so they can be reassembled in the same relative position. Place the assembly in a press with the cover assembly up. Place a bar across the cover and compress the assembly until the release fingers are just free. Loosen locknuts and completely unscrew the finger adjusting screw (3—Fig. 102). Release the compressing pressure and disassemble the remaining parts.

Inspect all parts and renew those showing damage or wear.

To reassemble the unit, refer to Fig. 102 and proceed as follows: Place the 11-inch pressure plate (15) on work bench with friction face down. Install the purple paint marked Belleville washer (14) on pressure plate with convex side up and outer edge in counterbore of pressure plate. Align the previously affixed punch marks and install flywheel plate (13). Position the 9-inch (pto) driven disc (12) on flywheel plate with hub of same upward. Then, again aligning punch marks, install the 9-inch pressure plate (11). Install second (green paint marked) Belleville washer (10) on pressure plate (11) with concave side up. Align punch marks and place clutch cover (9) in position, making certain that outer edge of Belleville washer is in counterbore of cover. Start clutch finger adjusting screws (3) and tighten only enough to hold clutch parts in position.

Install a NEW 11-inch driven disc in flywheel, with hub pointing away from engine. Position clutch assembly on flywheel and start the retaining cap screws. Install aligning tool (pilot) and tighten cap screws.

NOTE: It is important that a new 11-inch driven disc be used during adjustment of clutch fingers and pto adjustment screws. The original 11-inch disc can be reinstalled after adjustment is complete providing it is in serviceable condition.

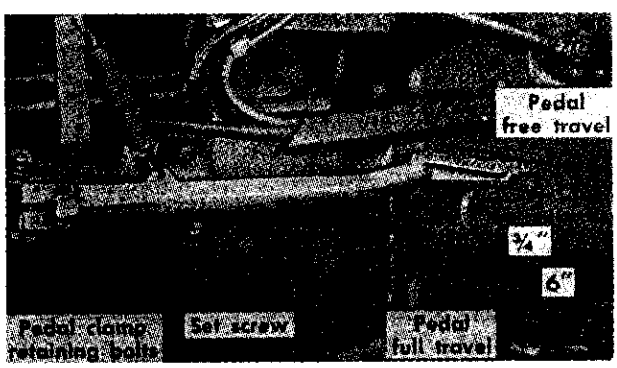


Fig. 101—View showing clutch pedal adjustment on Series 424, 444, 2424 and 2444 tractors.

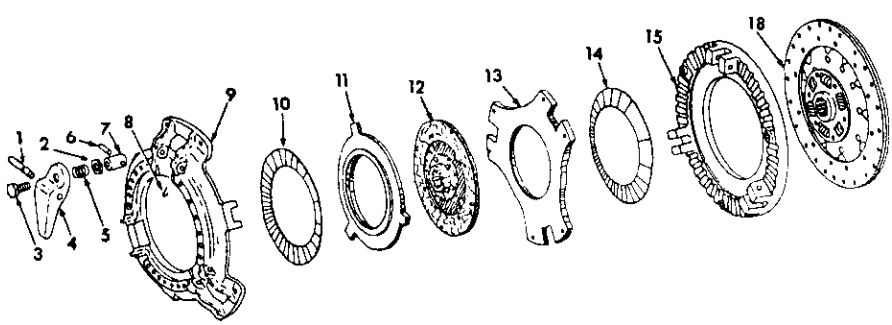


Fig. 102—Exploded view of Series 424, 444, 2424 and 2444 dual plate clutch assembly.

1. Pivot pin
2. Locknut
3. Adjusting screw
4. Clutch finger
5. Spring
6. Pivot block pin
7. Pivot block
8. Retainer
9. Clutch cover
10. Belleville washer
11. Pto pressure plate
12. Pto driven disc
13. Flywheel plate
14. Belleville washer
15. Pressure plate
18. Main driven disc

To adjust clutch, refer to Fig. 97 for tools required and proceed as follows: With clutch finger height gage in position as shown in Fig. 98 and while holding down slightly on finger to take out the slack, turn finger adjusting screw until the 2-25/32 inch dimension (X—Fig. 97) is obtained and tighten locknut. Repeat same procedures on other fingers. It is IMPORTANT that clutch fingers be adjusted to within 0.015 of each other. Use a box wrench or similar tool, and actuate each finger through its normal range of travel several times and recheck adjustment.

With finger adjustment completed, refer to Fig. 99 and set the clearance between the 9-inch pressure plate and adjusting cap screws. Loosen locknuts and turn adjusting screw until the 0.080 thickness gage can just be inserted between head of adjusting screw and 9-inch pressure plate. Tighten locknuts.

154. **OVERHAUL (SINGLE PLATE).** With tractor split as outlined in paragraph 152, unbolt and remove clutch assembly from flywheel. Disassembly procedure is obvious upon examination of the unit and reference to Fig. 103.

Clutch pressure springs should have a free length of 3.852 inches and should test 152 lbs. when compressed to a length of 2.062 inches. Adjust clutch release fingers to a height of 2.569 inches, measured from contacting surface of fingers to friction face of pressure plate. Clutch cover to pressure plate friction face distance should be 1.006 inches.

The "Dyna-Life" clutch driven disc (11—Fig. 103) is available as a unit only.

RELEASE BEARING

All Models

155. To remove the release bearing first split tractor as outlined in paragraph 146 or 152. Disconnect the clutch pedal return spring and remove snap ring or cotter pin and washer from right hand end of clutch cross-shaft. Remove bolts and key from release fork then tap cross-shaft toward left side of clutch housing until release fork comes off cross-shaft. Release fork, bearing and sleeve can now be removed by removing the three retaining cap screws. Any further disassembly and/or overhaul is obvious.

NOTE: On Series 424, 444, 2424, 2444, B-414, 354, 364 and 384, inserts (sleeves) are used on the lugs of the release bearing sleeve; when reassembling be sure flange of insert is between release fork and bearing sleeve.

CLUTCH SHAFT

All Models

156. The clutch shaft for models not equipped with forward and reverse transmission is the transmission input shaft. For information concerning this shaft, refer to paragraphs 161 and 162.

The clutch shaft for models equipped with forward and reverse transmission is the input shaft for the forward and reverse transmission. For information concerning this shaft refer to paragraph 167.

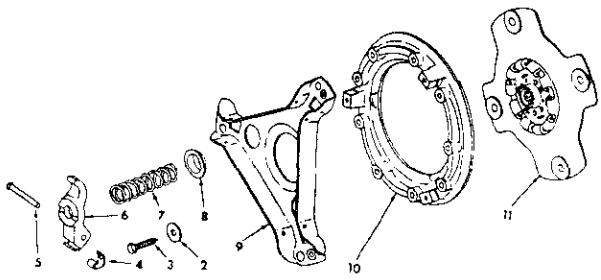


Fig. 103—Exploded view of the single plate clutch assembly used on Series 424, 444, 2424 and 2444 tractors without constant running pto.

2. Washer
3. Adjusting screw
4. Return clip
5. Pivot pin
6. Clutch finger
7. Pressure spring
8. Spring cup
9. Clutch cover
10. Pressure plate
11. "Dyna-Life" driven disc

TRANSMISSION

All Models

157. **MAJOR OVERHAUL.** Data for removing and overhauling the various transmission components are as follows:

158. SHIFTER RAILS AND FORKS. To remove the transmission top cover on Series B-275, disconnect hose from hydraulic system suction line and catch the hydraulic oil. Unbolt hydraulic control valve lever quadrant from reservoir, then remove the suction filter. Disconnect hydraulic pressure line from control valve, then unbolt and remove hydraulic control valve. Place both shifter levers in neutral, then unbolt and remove transmission top cover. See Fig. 104.

159. To remove the transmission top cover on Series 424, 444, 2424, 2444, B-414, 354, 364 and 384, disconnect hose from hydraulic system filter and catch oil, then remove the suction filter. Disconnect the pressure line from cylinder head of control valve. Unbolt hydraulic lift housing from rear frame and either remove the housing, or block it up high enough to allow removal of transmission top cover.

Place both shifter levers in neutral position, then unbolt and remove transmission top cover. See Fig. 104.

160. With transmission top cover removed, secure same in a vise, straighten cap screw locks (28—Fig. 105), then unbolt and remove guide brackets (27). Shifter forks, rail guides and detents can now be removed. Further disassembly, if required, is obvious.

161. DRIVING (INPUT) SHAFT. To remove the transmission driving (input) shaft, the transmission case must be separated from clutch housing as follows: Disconnect hydraulic system suction line from lower right front of

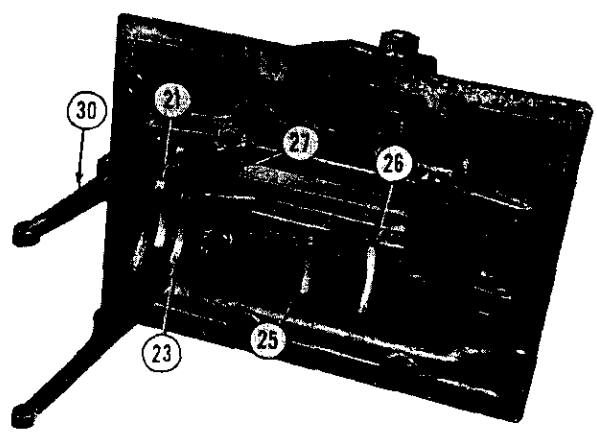


Fig. 104—View of the assembled gear shifting mechanism contained in the transmission top cover. Mechanism will differ on 424, 444, 2424, 2444, B-414, 364 and 384 tractors equipped with forward and reverse transmission. Refer to Fig. 105 for legend.

hydraulic reservoir and drain system. Disconnect hydraulic pressure line from control valve. Remove lower instrument plate, disconnect rear side light wire and remove clip which retains hydraulic lines to fuel tank support. Unbolt front of left step plate from clutch housing then, if equipped with downswept exhaust, either disconnect muffler from rear frame or exhaust pipe from manifold. On Series 354, 364 and 384, disconnect foot accelerator if so equipped, disconnect wiring harness at connector under fuel tank, then unbolt footplate from transmission case and clutch housing. On all series, drain oil from transmission and on dual plate clutch models, drain clutch housing. Remove all covers from bottom of clutch housing and if tractor is a dual plate clutch model remove the plug and "O" ring from clutch housing at front of pto driven shaft. Remove snap ring and washer or nut and washers from end of shaft. If tractor is equipped with forward and reverse transmission, disconnect shifter lever link, remove shaft retaining plate and shims, then pull shifter shaft connector shaft outward as far as it will go. Wedge front axle to prevent tipping, support both sections of tractor, then unbolt and separate transmission from clutch housing. See Fig. 106.

NOTE: On tractors equipped with transmission driven pto, six mounting cap screws are located inside the clutch housing. On tractors equipped with constant running pto, four mounting cap screws are located inside the clutch housing.

162. With transmission separated from clutch housing, remove the hydraulic control valve and the transmission top cover as outlined in paragraphs 158 or 159. Engage pto shifter lever, then unbolt retainer (2, 17, 24 or 31—Fig. 107) and remove the pto rear shaft assembly.

NOTE: If it is desired to remove clutch (10) it will be necessary to remove snap ring (6, 21, 27 or 34) before clutch will pass through bearing bore.

On models with dual plate clutches, and no forward and reverse transmission, remove the front pto shaft (29—Fig. 106) by sliding same rearward after disengaging clutch and either removing same from housing or allowing it to remain on floor of housing. On dual plate clutch models, remove countershaft nut (40—Fig. 108) then remove bearing retainer (41). On single plate clutch models, remove retainer (41—Fig. 109), then remove countershaft retainer (45).

On models with direction reverser, remove retainer (46—Fig. 108) and loosen nut (40). Loosen direction reverser housing from face of transmission housing and pull direction reverser unit as far forward as possible, then complete removal of nut (40) and lockwasher (39). Slinger (45) must be removed prior to removal of front pto shaft.

On all models, remove bearing (38) from front end of countershaft.

NOTE: It is highly recommended that International Harvester tool FES 44-3 be used to remove bearing and snap ring assembly (38). Bearing is a tight fit on countershaft and if wedged off by using pinch bars, damage to snap ring and/or bearing could result.

On all models with no direction reverser, remove cap screws from input shaft bearing retainer (25). On models with direction reverser, complete removal of direction reverser housing retaining cap screws, if necessary.

Push down on forward end of countershaft to provide clearance for teeth of input shaft and withdraw input shaft or reverser unit.

Any further disassembly of the input shaft used on models with no direction reverser is obvious. For information on the input shaft used in models with direction reverser, refer to paragraph 167.

163. SPLINE SHAFT. Removal of the spline shaft requires removal of the hydraulic lift attachment (or the housing rear top cover), in addition to split

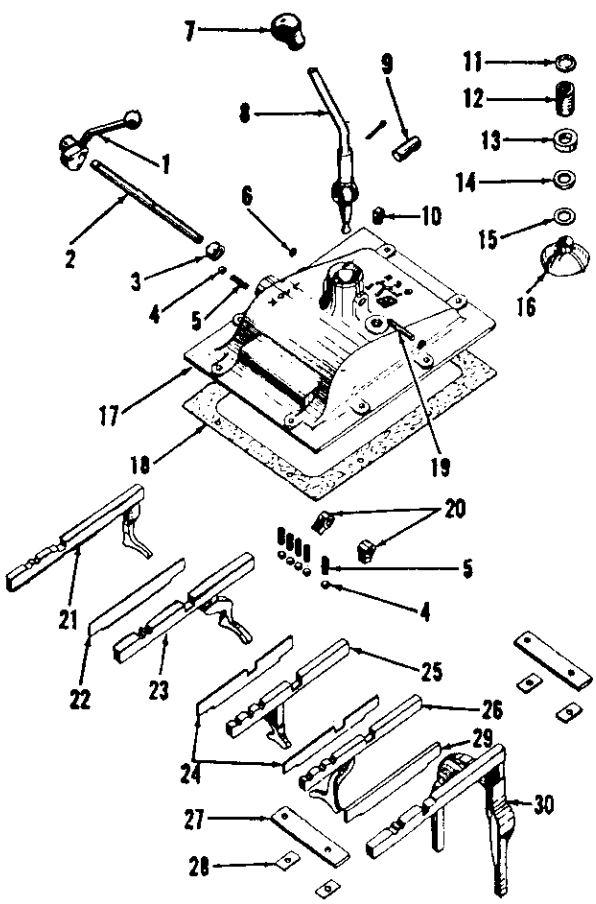


Fig. 105—Exploded view of the gear shifting mechanism.

1. High-Low range shifter
2. Shifter shaft
3. Oil seal
4. Detent ball
5. Detent spring
6. Expansion plug
8. Gearshift lever
9. Large swivel shaft
10. Filler plug
11. Spring stop
12. Spring
13. Retainer
14. Felt washer
15. Plain washer
16. Shield
17. Transmission top cover
18. Gasket
19. Small swivel shaft
20. High-Low shifter cam
21. High speed shifter fork
22. Left rail guide
23. 4th speed shift fork
24. Inner rail guides
25. 2nd & 3rd shift fork
26. 1st & rev. shift fork
27. Fork & guide bracket
28. Lock
29. Right rail guide
30. Low speed shift fork

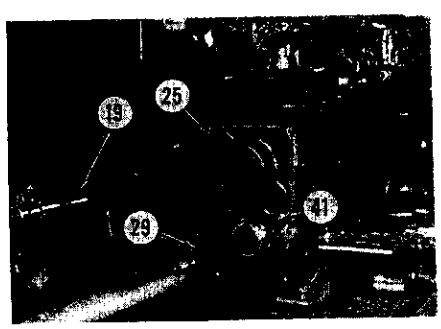


Fig. 106—Transmission assembly shown separated from clutch housing. Tractor shown is a B-275 dual plate clutch model, however, B-414, 424, 444, 2424, 2444, 354, 364 and 384 series tractors are similar. Single plate clutch models will not have front pto shaft (29) and will have a cover type retainer instead of retainer (41) shown.

ting the tractor and removing the driving (input) shaft or direction reverser as outlined in paragraphs 161 and 162.

With tractor split and the driving (input) shaft or direction reverser removed, disconnect lift arms from rockshaft, then unbolt and lift off hydraulic lift assembly. Unbolt the spline shaft bearing retainer (6—Fig. 108 or 109) and withdraw spline shaft as a unit. See Fig. 110.

NOTE: On Series 354, 364 and 384, the spline shaft and bevel ring gear have been cut using either the Oerlikon or Gleason system of gear cutting, resulting in different tooth curvature. The spline shaft with Gleason cut teeth can be removed without disturbing the bevel ring gear. On tractors having the Oerlikon cut teeth, remove right brake housing and loosen right bull pinion bearing cage cap screws to provide the necessary clearance to remove the spline shaft assembly.

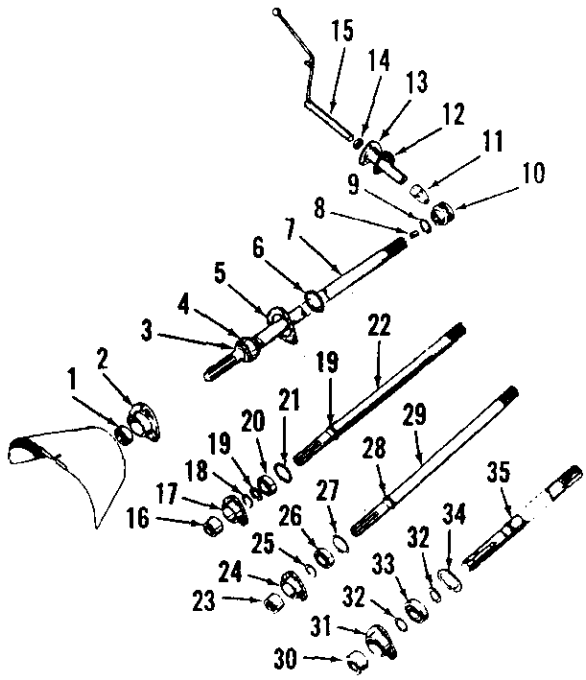
On all series, after removing gears from spline shaft, disassembly can be completed as follows: Unstake lockwasher (10—Fig. 108 or 109) and remove locknuts (9). Use a suitable press and press spline shaft out of tapered bearings. Save spacer (4) and shims present for subsequent reinstallation. Bearing cups can be driven from retainer.

164. If original parts are to be used, reassemble components to shaft by reversing disassembly procedure. However, if incorrect bearing adjustment is suspected, or new parts are installed, check the bearing preload as follows: Assemble bearings, spacer, shims, and bearing retainer to spline shaft and tighten locknuts securely. Clamp spline shaft in a vise, wrap a length of cord around bearing retainer and check the amount of pull on a spring scale required to keep the bearing retainer rotating. This measurement should be 3-6 lbs. on the spring scale which is equivalent to 5-15 in.-lbs. preload. If preload is not as specified, vary shims between spacer (4—Fig. 108 or 109) and bearings until preload is correct. Shims are available in thicknesses of 0.002, 0.004 and 0.010. Stake lockwasher when adjustment is completed. Check and adjust, if necessary, the cone center depth as outlined in paragraph 170.

165. COUNTERSHAFT. Removal of transmission countershaft can be accomplished after spline shaft is removed as outlined in paragraph 163.

With spline shaft removed, remove snap ring (27—Fig. 108 or 109) and drive bearing (28) from countershaft

Fig. 107—Exploded view of various pto rear (output) shafts. Items 1 through 7 are used on Series 354, 364 and 384, items 16 through 22 are used on 424, 2424, 444 and 2444, items 23 through 29 are used on B-414 and items 30 through 35 are used on B-275.



1. Oil seal
2. Retainer
3. Collar
4. Bearing
5. Gasket
6. Snap ring
7. Shaft
8. Bushing
9. Snap ring
10. Clutch
11. Shifter
12. Gasket
13. Bracket
14. Oil seal
15. Shift lever
16. Oil seal
17. Retainer
18. Snap ring
19. Collars
20. Bearing
21. Snap ring
22. Shaft
23. Oil seal
24. Retainer
25. Snap ring
26. Bearing
27. Snap ring
28. Collar
29. Shaft
30. Oil seal
31. Retainer
32. Snap ring
33. Bearing
34. Snap ring
35. Shaft

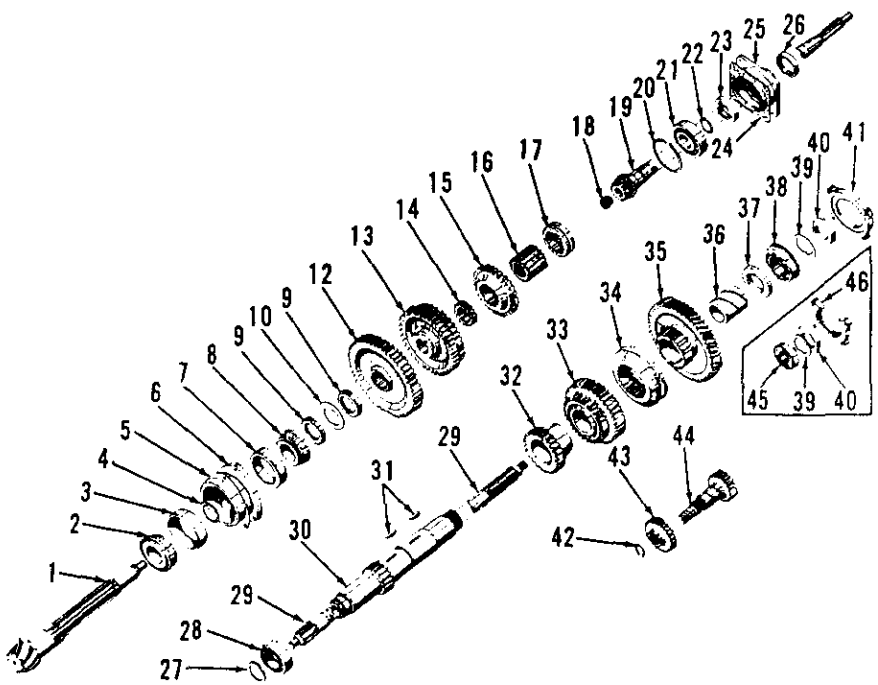


Fig. 108—Exploded view of transmission shafts, gears and component parts used when tractor is equipped with constant-running pto (dual plate clutch). Items shown in inset are used when equipped with forward and reverse transmission. Refer also to Fig. 109.

1. Spline shaft
2. Bearing cone
3. Bearing cup
4. Spacer
5. Shims
6. Bearing retainer
7. Bearing cup
8. Bearing cone
9. Locknut
10. Lockwasher
12. 1st & rev. sliding gear
13. 2nd & 3rd sliding gear
14. 4th & direct gear coupling
15. 4th & direct sliding gear coupling
16. Sliding quill gear
17. Coupling
18. Pilot bearing
19. Driving (input) shaft
20. Snap ring
21. Ball bearing
22. Snap ring
23. Driving shaft oil seal
24. Gasket
25. Bearing retainer
26. Pto driving shaft oil seal
27. Snap ring
28. Ball bearing
29. Front pto shaft
30. Countershaft
31. Woodruff keys
32. 2nd speed drive gear
33. 3rd & 4th speed driving gear
34. Coupling
35. Constant mesh gear
36. Bushing (cast iron)
37. Spacer
38. Ball bearing & snap ring
39. Lockwasher
40. Locknut
41. Bearing retainer
42. Snap ring
43. Rev. idler driving gear
44. Rev. idler gear & shaft
45. Slinger
46. Bearing retainer

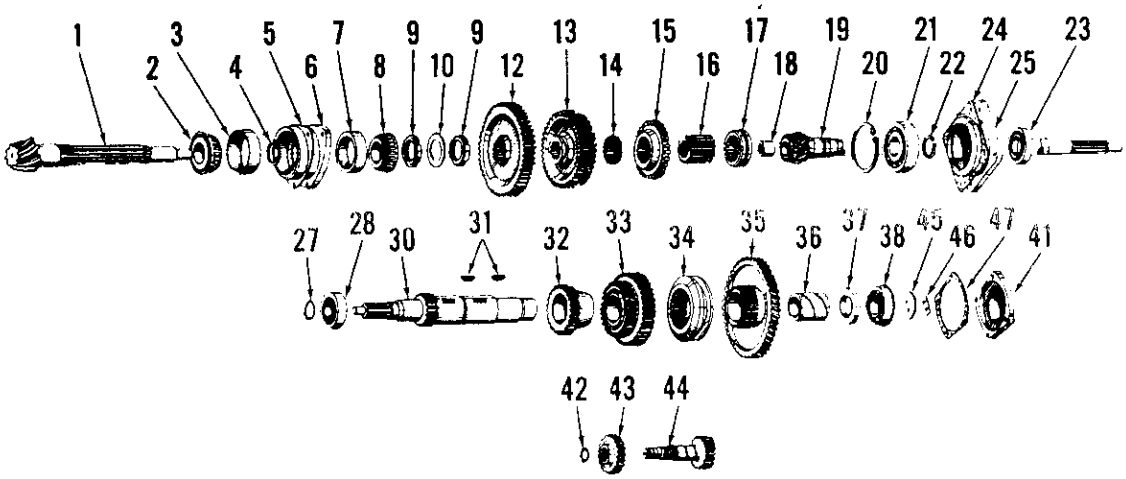


Fig. 109—Exploded view of the transmission shafts, gears and component parts used when tractor is equipped with transmission driven pto (single plate clutch). Note the solid countershaft (30). Refer also to Fig. 108.

1. Spline shaft
2. Bearing cone
3. Bearing cup
4. Spacer
5. Shims
6. Bearing retainer
7. Bearing cup
8. Bearing cone
9. Locknut
10. Lockwasher
12. 1st & rev. sliding gear
13. 2nd & 3rd sliding gear
14. 4th & direct gear coupling
15. 4th & direct sliding gear
16. Sliding quill gear
17. Coupling
18. Pilot bearing
19. Driving (input) shaft
20. Snap ring
21. Ball bearing
22. Snap ring
23. Oil seal
24. Gasket
25. Bearing retainer
27. Snap ring
28. Ball bearing
30. Countershaft
31. Woodruff keys
32. 2nd speed drive gear
33. 3rd & 4th speed driving gear
34. Coupling
35. Constant mesh gear
36. Bushing (cast iron)
37. Spacer
38. Ball bearing & snap ring
41. Bearing retainer
42. Snap ring
43. Rev. idler driving gear
44. Rev. idler gear & shaft
45. Retaining washer
46. Lock plate
47. Gasket

using a soft drift positioned on inner race of bearing. Lift out countershaft.

Slide off constant mesh gear (35) and bushing (36). Gears (32 and 33) can now be pressed from shaft. See Fig. 111.

NOTE: When reinstalling countershaft, bear in mind that the front end will have to be pushed downward before driving (input) shaft can be installed.

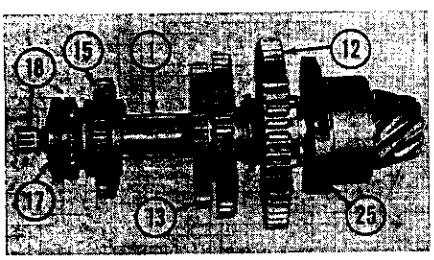


Fig. 110—Removed spline shaft showing gears and pilot bearing (18). Refer to Fig. 108 or 109 for legend.

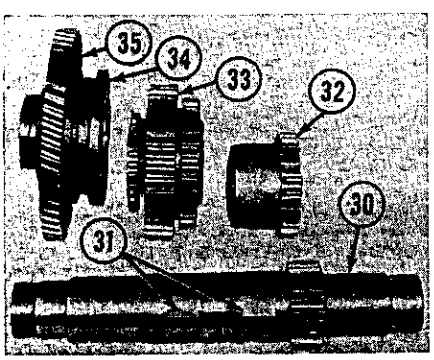


Fig. 111—Dismantled countershaft from tractor having dual plate clutch. Note the hollow shaft. Refer to Fig. 108 for legend.

Install the countershaft as follows: Place gears on shaft and install assembly in housing. Install front bearing and bearing retainer to position shaft, then install rear bearing and snap ring. Remove front bearing retainer and bearing and install spline shaft and input shaft, or direction reverser shaft. Reinstall front bearing, bearing retainer and nut (or retaining washer) and tighten nut (40—Fig. 108) to a torque of 30-35 ft.-lbs. Check end play of constant mesh gear (35) which should be 0.005-0.010. If end play is insufficient, drive countershaft forward and retorque nut or retaining washer cap screws.

NOTE: Insufficient end play of constant mesh gear can only be caused by incorrect assembly of countershaft components.

166. REVERSE IDLER. To remove the reverse idler assembly, first remove the driving (input) shaft or direction reverser, spline shaft and countershaft as outlined in paragraph 161 through 165, then remove snap ring (42—Fig. 108 or 109) and remove reverse idler assembly from housing.

NOTE: Some mechanics prefer to remove the right bull gear to provide easier access to snap ring.

Check reverse idler gear shaft and bushings against the values which follow:

Shaft front diameter	1.249-1.250
Shaft rear diameter	0.991-0.992
Front bushing inside diameter	1.251-1.253
Rear bushing inside diameter	0.993-0.995
Operating clearance	0.001-0.004

When renewing reverse idler bushings, install bushings with the split at the bottom. Remove expansion plug at front of transmission case and ream bushings to specified size. Use sealing compound and renew expansion plug.

FORWARD AND REVERSE TRANSMISSION

Series B-414-424-444-2424-2444-364-384

Series B-414, 364, 384, 424, 444, 2424 and 2444 tractors are available with a forward and reverse transmission which provides eight speeds in reverse as well as the eight forward speeds. Transmission is a self-contained unit mounted on front face of main transmission housing and is controlled by a lever mounted on left side of clutch housing. See Fig. 112.

167. **R&R AND OVERHAUL.** To remove the forward and reverse trans-

mission, split tractor between clutch housing and transmission as outlined in paragraph 161.

With tractor split, remove bearing retainer (46—Fig. 108), and loosen nut (40) until it reaches cluster gear of direction reverser. Loosen (or remove) the nuts and cap screw which retain direction reverser to transmission housing and pull unit forward as far as possible. Complete removal of nut (40) and lockwasher (39). Remove bearing and snap ring assembly (38). Push down on forward end of countershaft to provide clearance and withdraw the forward and reverse unit.

NOTE: It is highly recommended that International Harvester tool FES 44-3 be used to remove bearing and snap ring (38). Bearing is tight fit on countershaft and if wedged off by using pinch bars, damage to snap ring and/or bearing could result.

With unit removed, refer to Fig. 113, remove lockbolt (23), then drive roll pin (28) from countershaft (26) and remove countershaft, spacer (30) and cluster gear (33). The two needle bearings (32) can now be removed from cluster gear, if necessary.

Remove lockbolt (23) and snap ring (41) from idler shaft, then slide thrust washer (40) rearward and remove the small locking pin from its bore in idler shaft. Idler gear shaft (29), idler gear (36), needle bearing (38), bearing sleeve (39) and thrust washers (34) can now be removed. Needle bearing can now be removed from idler gear, if necessary.

Remove shifter rail (24), detent ball (11) and detent spring (10), then remove snap ring (4) and bump input shaft (3) and bearing assembly (5) from housing. Bearing can be removed from input shaft after removing snap ring (6).

Remove snap ring (12) and input gear (13) from aft end of clutch shaft (17), remove fork shoes (8), then bump clutch shaft (17) forward and out of bearing. Remove snap ring (14) and bump bearing (15) rearward out of housing. Oil seal (21) and pilot bearing (16) can now be removed, if necessary.

Drive roll pins from shifter fork (9) and shaft (20) and remove fork and shaft.

Inspect all gears for chipped, broken or unduly worn teeth. Check shifter fork shoes in groove of output gear and renew shoes and/or gear if excessive clearance is present. Check condition of thrust washers and needle bearings of cluster gear and idler gear, and pay particular attention to bearing sleeve (39). Be sure the small sealing ball (25) is securely in place in forward end of

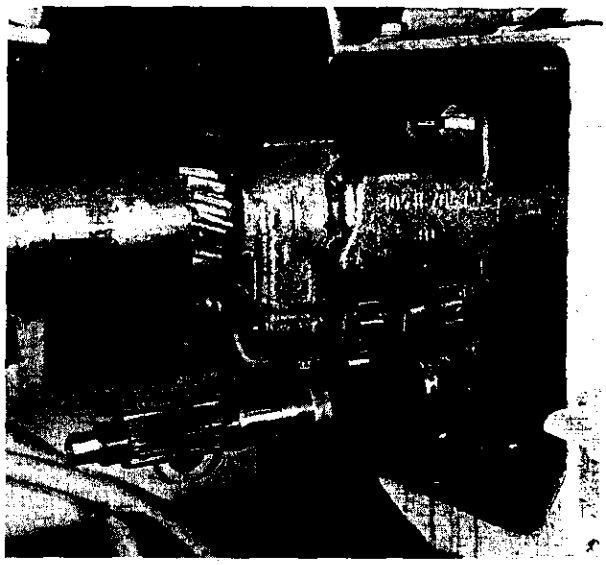


Fig. 112—Forward and reverse transmission mounts on front face of transmission housing as shown.

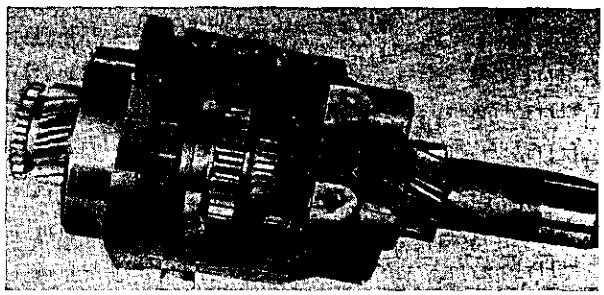


Fig. 112A—Forward and reverse transmission with cluster gear and idler gear removed.

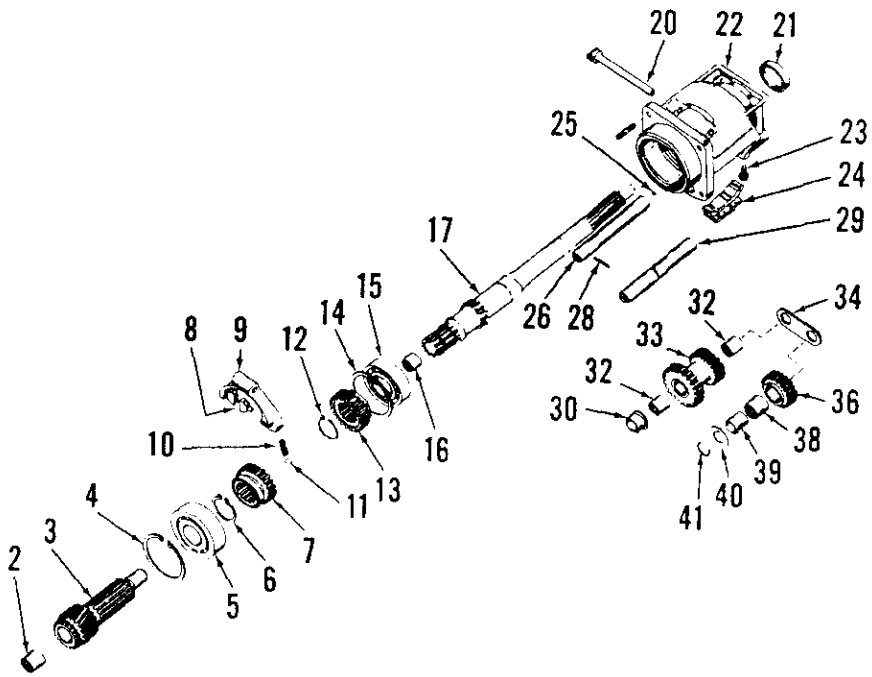


Fig. 113—Exploded view of the forward and reverse transmission which is available for the Series 364, 384, 424, 444, 2424, 2444 and B-414 tractors.

2. Pilot bearing
3. Transmission input shaft
4. Snap ring
5. Ball bearing
6. Snap ring
7. Output gear
8. Shifter fork shoes
9. Shifter fork
10. Poppet spring
11. Poppet ball
12. Snap ring
13. Input gear
14. Snap ring
15. Ball bearing
16. Needle bearing
17. Clutch shaft
20. Shifter fork shaft
21. Oil seal
22. Housing
23. Locking bolt
24. Shifter rail
25. Steel ball
26. Countershaft
28. Groove pin
29. Idler shaft
30. Spacer
32. Needle bearing
33. Cluster gear
34. Thrust washer
36. Idler gear
38. Needle bearing
40. Thrust washer
41. Snap ring

cluster gear shaft. Ball bearings should turn freely with no lumpy (tight) spots.

Reassemble by reversing the disassembly procedure. Oil seal (21) is installed with lip facing toward rear of housing. Large gear of countershaft cluster gear (33) is toward rear. Shifter groove of output gear (7) is toward rear. The small locking pin in idler gear shaft fits in notch of thrust washer (40).

Reinstall by reversing the removal procedure and tighten the countershaft nut (40—Fig. 108) to a torque of 30-35 ft.-lbs.

MAIN DRIVE BEVEL GEARS AND DIFFERENTIAL

RENEW BEVEL GEARS

All Models

168. To renew the bevel pinion, follow the procedure for overhaul of spline shaft given in paragraphs 163 and 164. To renew the main drive bevel ring gear, follow the procedure for overhaul of differential in paragraph 173.

Neither bevel pinion, nor ring gear, are available separately and renewal of one necessitates the renewal of the other. After renewal of gears, check and adjust, if necessary, the carrier bearing adjustment, the mesh position and backlash as follows:

169. **DIFFERENTIAL BEARING PRELOAD.** Prior to making either the mesh or backlash adjustments, the preload on the differential carrier bearings should be established. To adjust the taper roller bearings (7—Fig. 115), first install more than enough shims (2) under each of the differential bearing cages so that differential has a slight amount of end play and make certain there is some backlash between the ring gear and pinion. Wind a cord around the machined diameter of left differential case half, attach spring scale to end of cord and check the amount of pull required to keep the differential rolling once it has started. Record this reading.

Now remove an equal amount of shims (2) from each side until the bearing preload requires 6 to 10 pounds more than the previously recorded pull on the spring scale to keep the differential rolling at a constant speed.

170. **MESH POSITION.** The mesh position (cone point distance) is controlled by shims (5—Fig. 108 and 109) located between spline shaft bearing retainer and wall of transmission case. The correct cone point distance will be found etched on the machined aft end of spline shaft and represents the distance from machined end of shaft to center line of differential. The nominal radius of the left hand differential case half is 3.938 inches at its machined surface, however, it should be measured at several points to insure accuracy. Mesh position is correct when the distance between end of spline shaft and machined surface of left half of differential case is equal to the difference between the etched cone point distance and the radius of the differential case. For example: If the etched cone center distance was 4.423 and the differential case radius 3.938, the difference would be 0.485 which is the measureable distance between end of spline shaft and the differential case. Shims are available in thicknesses of 0.0016, 0.006 and 0.0108.

NOTE: Do not confuse cone center point markings with the gear matching numbers.

171. **BACKLASH ADJUSTMENT.** After the carrier bearings are adjusted as outlined in paragraph 169, and the mesh position, adjusted as outlined in paragraph 170, the backlash can be adjusted as follows: Transfer shims (2—Fig. 115) from under one bearing cage to the other to provide correct backlash between teeth of the main drive bevel pinion and bevel ring gear. The backlash value will be etched on the outer machined face of the ring gear and may vary between gear sets. To decrease backlash, remove shim, or shims, from cage on bevel ring gear side of housing and install same under cage on opposite side. Only transfer shims, do not remove shims or the previously determine carrier bearing adjustment will be changed.

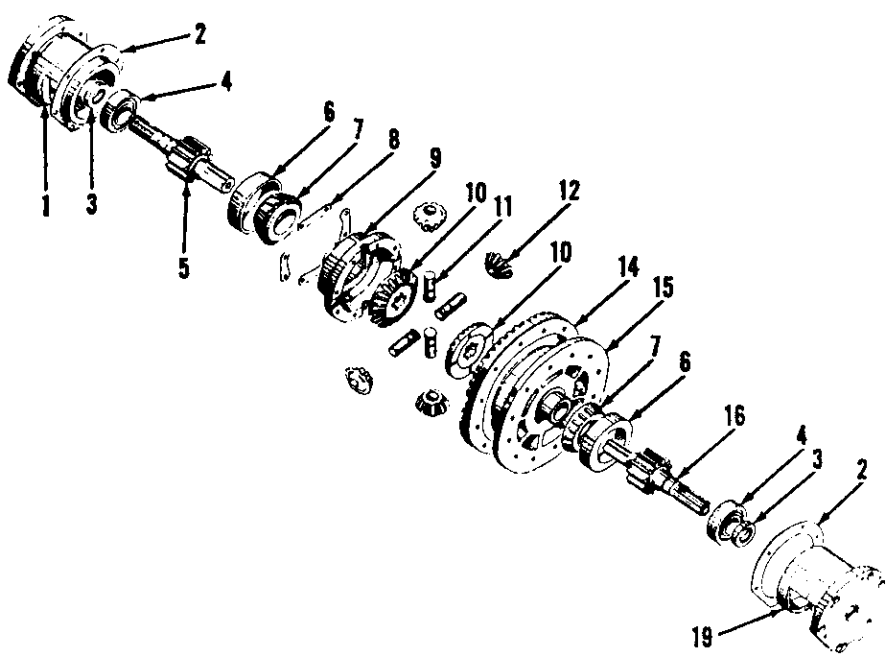


Fig. 115—Exploded view of differential, bull pinion shafts and associated parts. Shims (2) control carrier bearing preload and gear backlash adjustments.

1. L.H. bearing cage
2. Shims
3. Oil seal
4. Ball bearing
5. L.H. bull pinion
6. Bearing cup
7. Bearing cone
8. Lock plates
9. Left differential half
10. Differential side gear
11. Pinion shafts
12. Differential pinions
14. Bevel ring gear
15. Right differential half
16. R.H. bull pinion
19. R.H. bearing cage

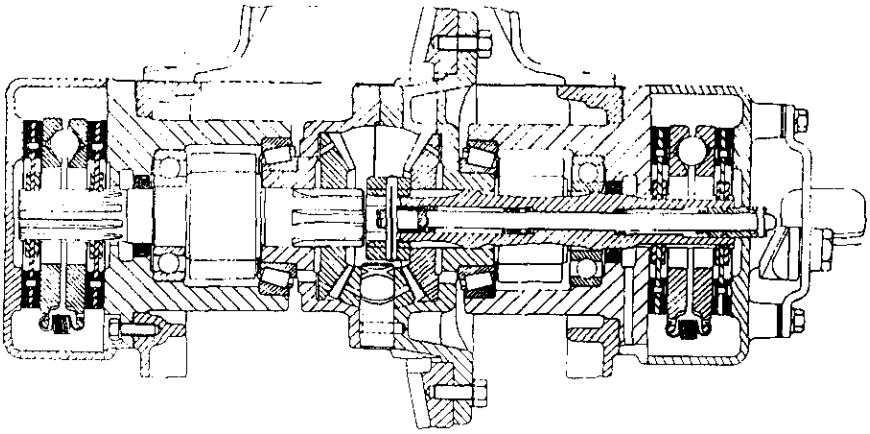


Fig. 116—Sectional view of differential, bull pinions and brakes. Note differential lock which operates through hollow right hand bull pinion shaft.

172. TOOTH CONTACT. If desired, the bevel pinion and bevel ring gear adjustment can be finally checked as follows: Paint several teeth at 90 degree intervals with Prussian Blue or red lead and rotate pinion in both directions. Correct adjustment will result in patterns similar to those shown in Figs. 117 and 118.

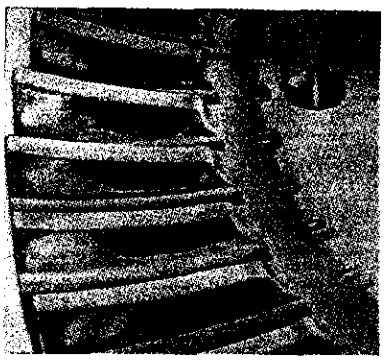


Fig. 117—Correct mesh and backlash will leave pattern shown when pinion shaft is turned to produce forward motion. Refer to text.

Fig. 118—Correct mesh and backlash will leave pattern shown when pinion shaft is turned to produce reverse motion. Refer to text.

DIFFERENTIAL AND CARRIER BEARINGS

All Models

173. **R&R AND OVERHAUL.** To remove the differential first drain transmission case, then either remove differential top cover, if so equipped, or drain and remove the hydraulic lift unit as outlined in paragraph 207 or 209. Support rear of tractor in a raised position and remove rear wheels. Wedge front axle as an aid to prevent tractor from tipping. Remove cap screws from bearing retainer of rear pto shaft and remove shaft and bearing assembly.

On Series B-275, B-414, 354, 364 and 384 unbolt right hand step plate (platform) and hand brake from right fender. Remove cap screw (1—Fig. 121) from inner end of axle shaft, unbolt axle carrier (8) and remove axle, axle carrier and fender as a unit.

On Series 424, 444, 2424 and 2444, unbolt and remove the right fender. Remove snap ring (1—Fig. 122) and unbolt bearing retainer (10), then withdraw axle shaft (11).

NOTE: The axle and axle carrier can be removed as a unit to renew axle carrier gasket (3).

On all models where axle is a tight fit in the bull gear hub, a cap screw and nut can be used in conjunction with a short piece of pipe as a pusher.

On Series 424, 444, 2424 and 2444 remove the battery, then on all models unbolt and remove the left fender. Follow same procedure as outlined before and remove left hand axle and axle carrier. Lift bull gears from rear frame.

With axle and axle carrier assemblies removed, remove the differential lock thrust plate and lever from right brake housing. Depress "O" ring retainer (8—Fig. 119) and remove the retaining ring.

On Series B-275 and early production B-414 tractors, loosen jam nut at brake operating rod and unscrew brake rod assembly from yoke.

On Series 354, 364, 384, 424, 444, 2424, 2444 and late production B-414 tractors, disconnect the brake pedal return springs and remove the brake adjusting rod pin.

Then, on all models, unbolt brake housing and remove housing, outer brake disc, actuating assembly and inner brake disc. Unbolt and remove bull pinion shaft bearing cage and bull pinion shaft. Bearing cages can usually be withdrawn with no difficulty, however, should a tight fit be encountered, tapped holes are provided for puller screws. Use of puller screws usually causes shim damage which requires renewal of shims.

Removal of left brake, bull pinion shaft bearing cage and bull pinion shaft is accomplished in a like manner except that no differential lock is involved.

Differential assembly can be lifted from rear frame after bull pinion shafts are removed.

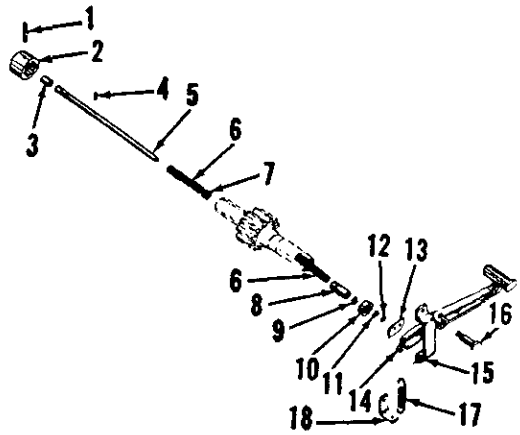


Fig. 119—Exploded view of the differential lock assembly.

1. Groove pin
2. Clutch
3. Spacer
4. Dowel pin
5. Shaft
6. Spring
7. Collar
8. "O" ring retainer
9. Inner "O" ring
10. Oil seal
11. Outer "O" ring
12. Retaining ring
13. Cam plate
14. Lever
15. Thrust plate
16. Pivot bolt
17. Return spring
18. Spring anchor

174. To inspect and/or overhaul removed differential, straighten lock plates (8—Fig. 115), unbolt and separate the differential case halves. Pinion shafts (11) can be driven off pins at this time. Any further disassembly and/or overhaul is obvious after an examination of the unit.

When reinstalling differential assembly, adjust preload on carrier bearings as outlined in paragraph 169. Adjust mesh position as outlined in paragraph 170 and backlash as outlined in paragraph 171.

DIFFERENTIAL LOCK

All Models

All tractors are equipped with a differential lock which operates through the right hand bull pinion shaft and is controlled by a foot pedal mounted on the right hand brake housing.

Operating the differential lock connects the two bull pinion shafts together which causes the differential to act as a solid hub and the driving wheels to operate as though they were on a common shaft.

Refer to Fig. 119 for an exploded view of the differential lock.

175. **R&R AND OVERHAUL.** Removal and overhaul of the differential lock requires removal and separation of the differential assembly as outlined in paragraphs 173 and 174.

Overhaul of the unit is obvious. Springs (6—Fig. 119) can be checked by using the following specifications:

Free length	3-5/8 in.
Test length	2-1/8 in.
Test load	54.8 lbs.

When reassembling, adjust differential lock thrust plate by means of adjustment washers until there is 1/32 to 1/16 inch clearance between cam plate and lock shaft as shown in Fig. 120.

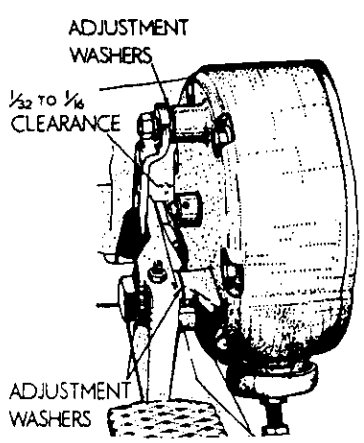


Fig. 120—Use adjustment weshers as shown to adjust cam plate clearance.

FINAL DRIVE

The final drive consists of two bull pinions and integral brake shafts and two bull gears which are splined to the inner ends of the rear axle shafts. Each axle shaft is carried in a sleeve which is bolted to the side of the transmission case.

All Models

176. **R&R WHEEL AXLE SHAFT.** To remove either wheel axle shaft, proceed as follows: Drain transmission housing. Remove rear frame top cover, if so equipped, or drain hydraulic lift reservoir and remove same as outlined in paragraph 207 or 209. Wedge front axle to aid in preventing tractor from tipping, then raise and support rear of tractor. Remove rear wheel and tire assembly. Disconnect rear light wires.

On Series B-275, B-414, 354, 364 and 384 remove cap screw (1—Fig. 121), unbolt axle carrier (8) and withdraw axle, axle carrier and fender assembly.

On Series 424, 444, 2424 and 2444, remove snap ring (1—Fig. 122), unbolt axle carrier (6) and withdraw axle, axle carrier and fender assembly.

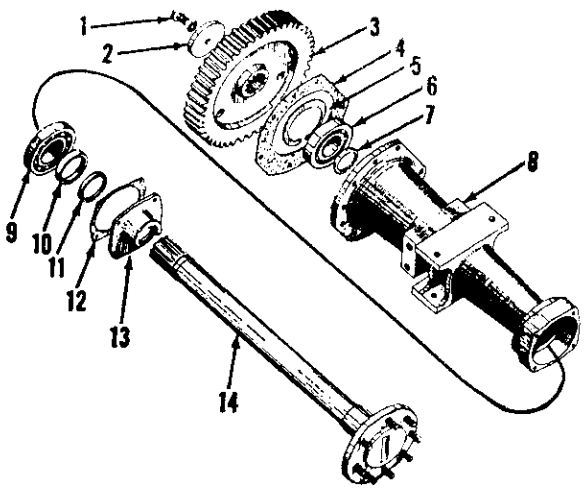


Fig. 121—Exploded view of axle, axle carrier and component parts used on Series B-275, B-414, 354, 364 and 384.

1. Cap screw
2. Retainer
3. Bull gear
4. Gasket
5. Snap ring
6. Ball bearing
7. Collar
8. Axle carrier
9. Ball bearing
10. Oil seal
11. Felt washer
12. Gasket
13. Bearing retainer
14. Axle shaft

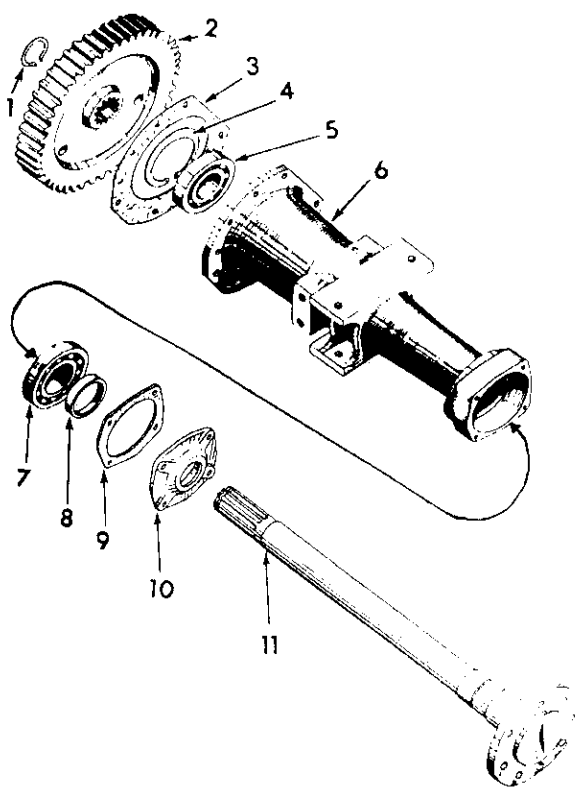


Fig. 122—Exploded view of axle, axle carrier and component parts used on Series 424, 444, 2424 and 2444.

1. Snap ring
2. Bull gear
3. Gasket
4. Snap ring
5. Ball bearing
6. Axle carrier
7. Ball bearing
8. Oil seal
9. Gasket
10. Bearing retainer
11. Axle shaft

NOTE: Although the axle carriers and fenders can be removed as a unit, some mechanics prefer to remove the fenders before removing the axle carriers.

Use a cap screw and nut in conjunction with a short piece of pipe if a pusher is required to push axle from bull gear.

With axle and carrier removed, unbolt bearing retainer, bump axle on inner end and drive axle out of axle carrier. Remove snap ring and drive out axle inner bearing. Any further disassembly required is obvious.

Use new oil seals and gaskets and reassemble by reversing the disassembly procedure.

177. **R&R BULL GEARS.** To remove the bull gears, first remove the wheel axle shafts as outlined in paragraph 176. Unbolt the rear pto shaft bearing retainer and remove the rear pto shaft. Bull gears can now be removed, however, the left bull gear must be out of housing before enough clearance is available to lift out right bull gear. Bear this is mind when occasions arise which dictate work on right bull gear.

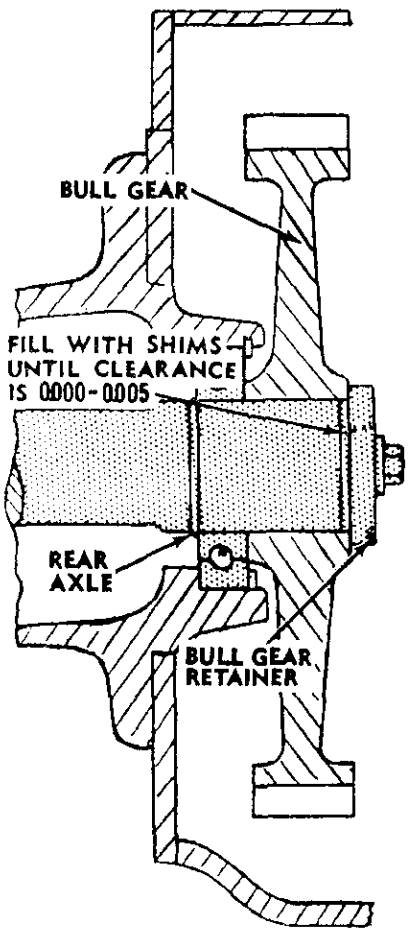


Fig. 123—Schematic view showing position of shims used to eliminate axle noises.

NOTE: In a few isolated cases a clicking noise has occurred in the axle and bull gear assembly of the Series B-275 tractors and the cause has been determined by the manufacturer to be excessive clamping between bull gear and axle. This noise is not conducive to failures, however, it may tend to be objectionable and may be eliminated as follows:

Remove rear frame top cover, if so equipped, or the hydraulic lift reservoir, then remove the cap screw and retaining washer from inner end of axle. Place a straightedge across hub of bull gear and measure distance between end of axle and straightedge. If this distance is excessive, add shims (IHC part No. 3042081R1) as shown in Fig. 123 until clearance is 0.000-0.005. Reinstall cap screw and retainer and hydraulic lift reservoir.

178. **R&R BULL PINION SHAFTS.** To remove either bull pinion shaft, first remove bull gear as outlined in paragraph 177. Remove right brake as follows: Remove differential lock thrust plate (15—Fig. 119) and lever (14). Push "O" ring retainer (8) inward and remove retainer (12). Disconnect the brake operating rod, then unbolt and remove brake housing, actuating assembly and inner disc. Left brake can be removed after brake operating rod is disconnected as no differential lock mechanism is involved.

Remove the cap screws which retain bull pinion shaft bearing cage to rear frame and withdraw same. Bearing cages usually are withdrawn with no difficulty, however, if difficulty is encountered tapped holes are provided in bearing cages to permit use of puller screws.

NOTE: The use of puller screws usually results in damage to shims (2—Fig. 115) and when renewing be sure to install the same thickness of shims as were removed in order to preserve the carrier bearing preload. Shims are available in thicknesses of 0.004, 0.007, 0.015 and 0.032.

Disassembly of the bull pinion shaft and bearing cage assembly is obvious after an examination of the unit and reference to Fig. 115. Bearing cup, shaft, ball bearing and oil seal are removed from inner end of bearing cage.

BRAKES

All Models

179. Brakes are double disc, self-energizing type and are splined to the outer ends of the bull pinion shafts. The moulded type linings are riveted to the discs and brake lining service packages are available for renewing the linings.

Series B-275 and early production B-414 tractors are equipped with the 5-3/8 inch brakes shown in Fig. 125. B-414 tractors having serial number 31374 and up (diesel) or 4360 and up (non-diesel) and all Series 354, 364, 384, 424, 444, 2424 and 2444 tractors are equipped with 6½ inch brakes. See Fig. 127.

180. **ADJUST.** To adjust the brakes on Series B-275 and early B-414 tractors, loosen jam nut (9—Fig. 124) and turn rod (3) either way as required to obtain a pedal free travel of ¾-inch. Tighten jam nut.

On Series 354, 364, 384, 424, 444, 2424, 2444 and late B-414 tractors, loosen the locknut and turn adjusting nut either way as required until 1¾-inches pedal free travel is obtained. Tighten locknut. Refer to Fig. 126 for location of adjusting nut.

To equalize the brakes on all models, first block up rear of tractor securely, start engine and shift transmission into

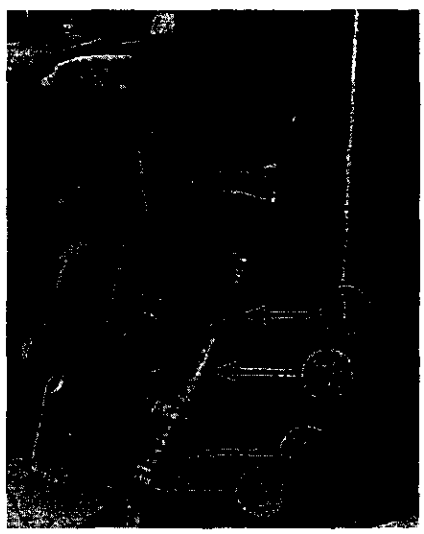


Fig. 124—Left brake of B-275 tractor showing brake rod and points of adjustment. Step plate has been removed for illustrative purposes. Early Series B-414 tractors are similar. Refer to Fig. 125 for legend.

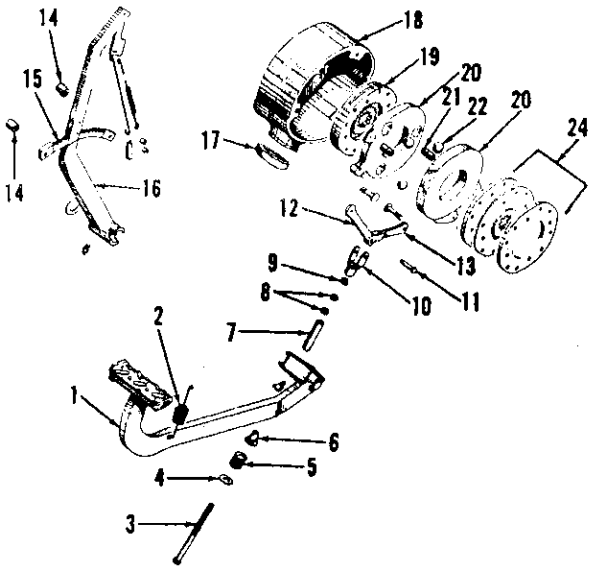


Fig. 125—Exploded view showing component parts of Series B-275 right hand disc brake assembly. Early Series B-414 are similar.

1. R.H. pedal
2. Return spring
3. Brake rod
4. Washer
5. Rod spring
6. Rod ball
7. Spacer
8. Jam nuts
9. Jam nut
10. Rod yoke
11. Pin
12. Male link
13. Female link
14. Spacers
15. Quadrant (rack)
16. Hand lever
17. Boot
18. Brake housing
19. Outer brake disc
20. Actuating disc
21. Extension spring
22. Steel ball
24. Inner brake disc

Disassembly of brakes is obvious upon examination of the units and reference to Figs. 125 and 127. Wash all parts except the linings in solvent. Inspect all parts and renew defective or worn parts as necessary.

On Series B-275 and early B-414 tractors, if brake operating rod is disassembled, reset the spring preload by turning down first jam nut (8—Fig. 125) until spring (5) is compressed solid, then back off nut three turns. Install second jam nut (8) and tighten against first to hold this setting.

On Series 424, 444, 2424, 2444 and late B-414 tractors, pin the brake operating rod in the front (19-1 ratio) hole in foot pedal for normal operation and in operations where increased braking is desired, install pin in rear (25-1 ratio) hole.

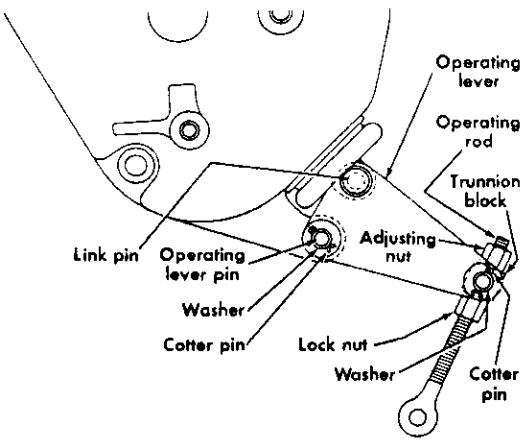


Fig. 126—View showing brake adjuster on Series 354, 364, 384, 424, 444, 2424, 2444 and late B-414 tractors.

third or fourth gear. With the pedals latched together, apply the brakes. If both wheel stop at the same time, the adjustment is satisfactory. If not, loosen the adjustment slightly on the tight brake until equalization is obtained.

181. **R&R AND OVERHAUL.** To remove right brake, proceed as follows: Remove differential lock thrust plate and pedal. On Series B-275 and early B-414 tractors, loosen jam nut (9—Fig. 125) and unscrew brake operating rod from yoke. On Series 354, 364, 384, 424, 444, 2424, 2444 and late B-414 tractors equipped with 6½-inch brakes, disconnect brake pedal return springs and remove the brake operating rod pin. Then, on all models, unbolt brake housing and remove housing, outer brake disc, actuating assembly and inner brake disc.

Left brake can be removed after disconnecting brake operating rod and unbolting brake housing from transmission housing.

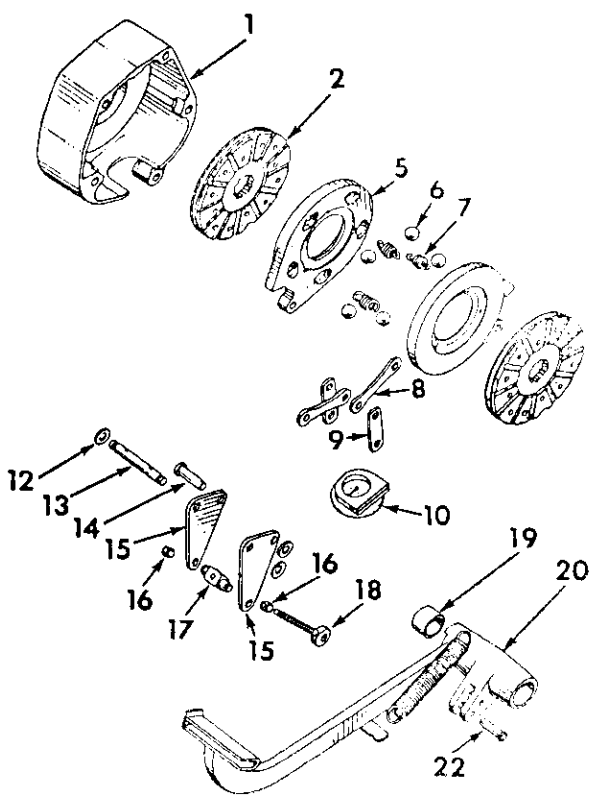


Fig. 127—Exploded view of the 6½-inch disc brake used on Series 354, 364, 384, 424, 444, 2424, 2444 and late B-414 tractors.

1. Brake housing
2. Brake disc
5. Actuating disc
6. Steel ball
7. Disc return spring
8. Actuating link
9. Tension link
10. Rubber boot
12. Washer
13. Operating lever pin
14. Pivot pin
15. Operating lever
16. Adjusting nut
17. Trunnion block
18. Operating rod
19. Bushing
20. Brake pedal R.H.
22. Operating rod pin

POWER TAKE-OFF

All Models

182. Tractors are available either with a transmission driven or a constant-running power take-off. Refer to paragraphs 187 through 189 for dual speed constant running pto used on some Series 354, 364 and 384 tractors.

When tractor is equipped with a transmission driven pto, the output shaft is driven by a solid transmission

countershaft. When tractor is equipped with constant-running pto, the pto driving shaft and transmission countershaft are both hollow. In both cases power is directed to the output shaft through a splined clutch (collar) located in the differential section of the transmission housing.

Refer to Fig. 128 for an illustration showing arrangement of shafts for the constant-running pto.

Fig. 128—Illustration showing shaft arrangement when tractor is equipped with single speed constant-running pto. Refer to Fig. 129 for legend.

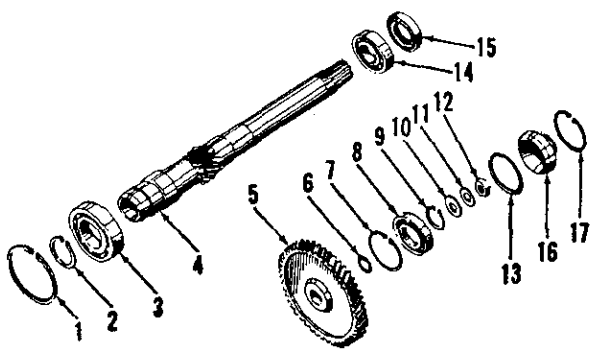


Fig. 129—Exploded view of pto driving shaft, driven gear and their component parts.

1. Snap ring
2. Snap ring
3. Ball bearing
4. Driving shaft
5. Driven gear
6. Snap ring
7. Snap ring
8. Ball bearing
9. Snap ring
10. Retaining washer
11. Lockwasher
12. Nut
13. "O" ring
14. Ball bearing
15. Oil seal
16. Cap (plug)
17. Snap ring

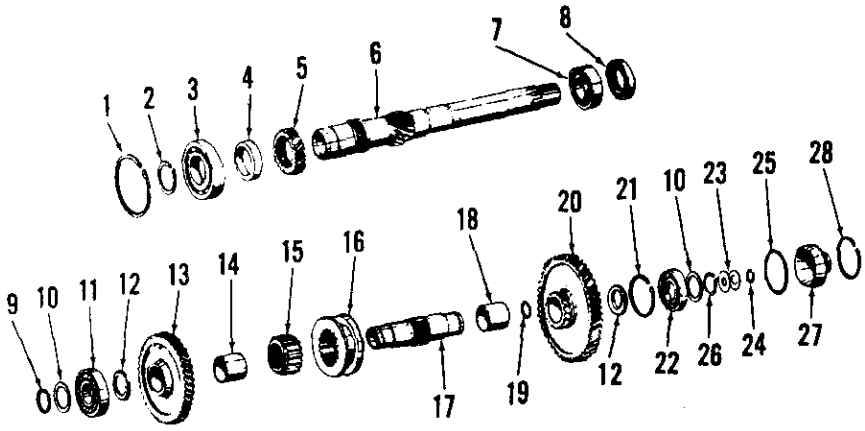


Fig. 130—Exploded view of dual speed pto driving shaft, pto countershaft and their component parts used on some Series 354, 364 and 384 tractors.

1. Snap ring
2. Snap ring
3. Rear bearing
4. Spacer
5. Driving gear
6. Driving shaft
7. Front bearing
8. Front seal
9. Snap ring
10. Retaining washer
11. Countershaft rear brg.
12. Spacer
13. Driven gear
14. Bushing
15. Clutch body
16. Coupling
17. Countershaft (pto)
18. Bushing
19. Snap ring
20. Driven gear
21. Snap ring
22. Front bearing
23. Retaining washer
24. Snap ring
25. "O" ring
26. Snap ring
27. Bearing cap
28. Snap ring

Occasions for overhauling the complete power take-off will be infrequent. Usually any failed or worn part will be so positioned that localized repairs can be made as outlined in the following paragraphs:

183. **REAR (OUTPUT) SHAFT.** To remove and/or overhaul the pto rear shaft, first drain transmission housing, then unbolt bearing retainer and shield and pull shaft from housing. Keep pto shift lever in engaged position so clutch (collar) will remain on aft end of transmission countershaft or front pto shaft. If desired, the clutch can be removed by disengaging snap ring from bearing bore at rear of transmission case, pushing shift lever forward and taking clutch out through bearing bore.

Overhaul is obvious after an examination of the unit and reference to Fig. 107. Oil seal in bearing retainer is installed with lip facing front of tractor.

NOTE: During reinstallation of rear shaft it may be necessary to remove shifter lever bracket to insure mating of clutch shifter with groove of clutch.

184. **COUNTERSHAFT OR FRONT PTO SHAFT.** On those models equipped with transmission driven pto, the pto output (rear) shaft is driven from a spline on the aft end of a solid transmission countershaft. Refer to paragraph 165 for information pertaining to this shaft.

185. On models equipped with a constant-running pto, the output shaft is driven by a front mounted shaft which runs through a hollow transmission countershaft and is splined to a gear which is driven from the hollow pto driving shaft. See Fig. 128.

The front pto shaft can be removed from the rear after removing bottom cover from clutch housing, nut or snap ring from front of shaft and the pto output shaft as outlined in paragraph 183.

186. **DRIVING SHAFT AND DRIVEN GEAR.** Due to the fit of bearings in their bores and on driving shaft (4—Fig. 129) and driven gear (5), plus the inaccessibility of the front of shaft and gear, it is usually necessary to perform the clutch split as outlined in paragraph 146 or 152 and the transmission split as outlined in paragraph 161. With the clutch housing removed as a unit, remove snap ring (9—Fig. 129) and press driven gear (5) from bearing (8). Remove "O" ring (13) and snap ring (7) and push bearing from its bore.

Remove snap ring (1) and press driving shaft (4) out rear of clutch housing.

Remove snap ring (2) and pull bearing (3) from shaft. Remove oil seal (15) and if bearing (14) has remained in its bore, remove same. Oil seal for aft end of driving shaft is contained in the transmission input shaft bearing retainer.

Dual Speed Constant Running Pto

187. Some Series 354, 364 and 384 tractors are equipped with a dual speed pto, which is similar to single speed constant-running pto except that the hollow driving shaft has two gears. See Fig. 130. These gears are in constant mesh with two gears (13 and 20) that are free wheeling on the pto countershaft (17). The countershaft is splined to the pto front shaft.

There is a sliding coupling on the pto countershaft which is operated by a lever on the right side of clutch housing. You may lock either of the free wheeling gears to the pto countershaft giving you either 540 rpm or 1000 rpm output shaft speed. Refer to paragraph 183 for R&R and overhaul procedure on rear (output) shaft.

188. **R&R DRIVING SHAFT AND COUNTERSHAFT.** To remove the pto countershaft first perform the clutch split as outlined in paragraph 146 or 152 and transmission split as outlined in paragraph 161. With housing removed as a unit, remove pto countershaft rear bearing snap ring (9—Fig. 130), retainer washer (10) and "O" ring (25). Drive the countershaft and front bearing forward into clutch housing compartment. Gears and coupling will be removed as the countershaft is removed. Remove snap ring (26) and press bearing (22) from countershaft. Remove bushing (18) from countershaft and snap ring (19) from inside of countershaft.

Procedure for removal of driving shaft is same as for single speed pto outlined in paragrah 184.

189. **R&R DUAL SPEED SHIFTER.** To remove the pto dual speed shifter, remove countershaft as outlined in paragraph 188. Loosen pinch bolt and remove operating lever (7—Fig. 131) from shaft. Remove bracket (4), shifter fork (1) and "O" ring (2). Reinstall by reversing the removal procedure.

NOTE: To adjust the shifter, loosen the pinch bolt, position shifter in center location hole in clutch housing. Move the clutch (16—Fig. 130) to neutral position, tighten pinch bolt.

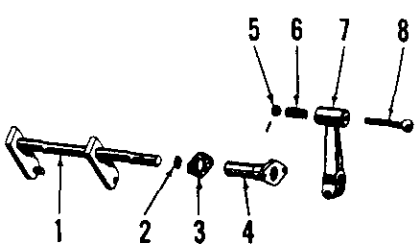


Fig. 131—Exploded view of the dual speed shifter located on right side of the clutch housing.

1. Shifter fork
2. "O" ring
3. Gasket
4. Bracket
5. Sleeve
6. Spring
7. Lever
8. Lever knob

BELT PULLEY

All Models

190. **R&R AND OVERHAUL (Clockwise Rotation).** The belt pulley unit bolts to the rear of the tractor rear frame and is driven by the power take-off. Removal of the unit from the tractor is obvious.

To disassemble, remove pulley, bearing retainer (19—Fig. 132), withdraw pinion shaft (12) and bearings, then remove spacer (16) from housing. Remove cover (1), using two of the bolts in extractor holes, bevel gear assembly and oil seal (8) from housing. Any further disassembly required will be obvious.

To reassemble, position bevel gear retaining bolts in the drive shaft (6—Fig. 132), press inner bearing (7) on the shaft and install bevel gear (4) using original shims (5). Measure from back face of bearing (7) to the front face of the gear (teeth side). The dimension should be between 3.554 to 3.564 inch for 550 rpm unit or 3.399 to 3.409 for 700 rpm unit. Add or remove shims (5) as required. Install the drive shaft assembly into the housing. Press the outer bearing (2) into the cover (1) and install the cover on the drive shaft until bearing contacts shoulder on the shaft. Measure the gap between the cover (1) and housing (9) and select shims (3) to give a total thickness greater than the gap. At least one shim will be required. Remove the drive shaft assembly. Press the oil seal (8) into housing, with the lip facing in toward bearing, until the back face of the oil seal is 1.88 inch from the mounting flange. Assemble the drive shaft

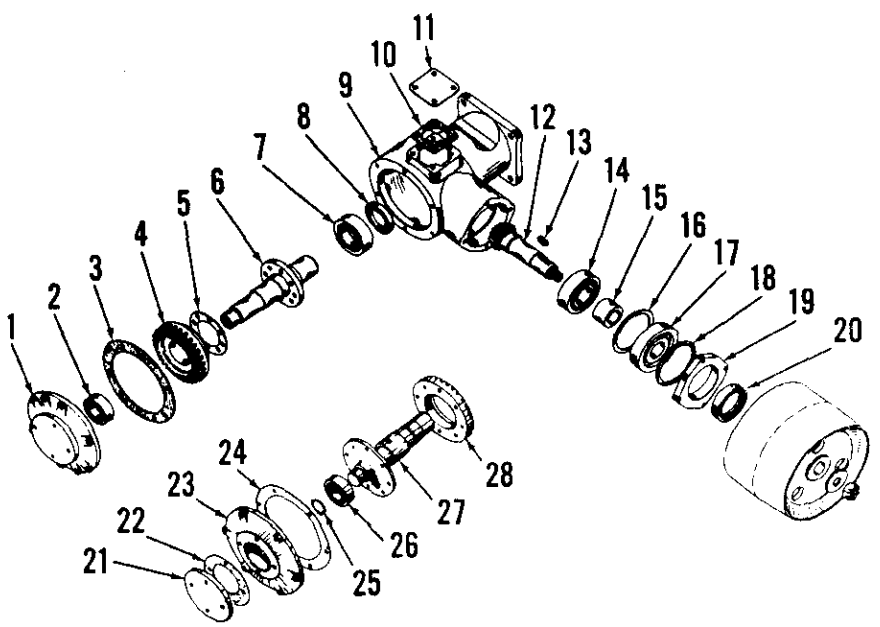


Fig. 132—Exploded view of the belt pulley unit. Drive is taken from pto shaft. Items 4 through 6 are used for clockwise rotation and items 27 and 28 are used for counter-clockwise rotation. Items 21 through 25 are used on early models.

1. Cover
2. Bearing
3. Shim
4. Bevel gear
5. Shim
6. Drive shaft
7. Bearing
8. Oil seal
9. Housing
10. Gasket
11. Plate
12. Pinion shaft
13. Woodruff key
14. Bearing
15. Spacer
16. Spacer
17. Bearing
18. Gasket
19. Bearing retainer
20. Oil seal
21. Bearing retainer
22. Gasket
23. Cover
24. Shim
25. Snap ring
26. Bearing
27. Drive shaft
28. Bevel gear

into housing take care not to damage oil seal (8). Install cover so that the extraction holes are at 5 and 11 o'clock positions.

Reverse the removal procedure for the pinion shaft using original spacers. Remove the inspection cover (11) and check backlash using a dial indicator. Backlash should be 0.005 to 0.007 inch. Add or remove spacers (16) to obtain correct backlash.

191. **R&R AND OVERHAUL** (Counter-clockwise Rotation). To disassemble, remove pulley, bearing retainer (19—Fig. 132), withdraw pinion shaft (12) and bearings, then remove spacer (16) from housing. Remove cover (1), using two of the bolts in the extractor holes, bevel gear assembly and oil seal (8). Any further disassembly required will be obvious.

To reassemble, press the oil seal (8) with the lip facing inward, toward the bevel gear. Position bevel gear (28) on drive shaft (27). Press inner and outer bearings on drive shaft, install snap ring (25). Press the outer bearing and shaft assembly into the cover (23). Install original shims (24) on cover, then install cover and shaft assembly into housing, taking care not to damage oil seal (8). Position cover so that the extraction holes are at 5 and 11 o'clock positions. Reverse the removal procedure for the pinion shaft using original spacers. Remove the inspection cover (11) and check backlash using a dial indicator. Backlash should be at 0.005 to 0.007 inch. Add or remove spacers (16) to obtain correct backlash.

HYDRAULIC LIFT SYSTEM

The hydraulic lift system is composed of three basic units: A pressure loaded gear type pump which is driven from the engine timing gear train; a control valve mounted on front side of reservoir and the reservoir which incorporates the work cylinder, rockshaft and operating linkage.

The maintenance of absolute cleanliness of all parts is of the utmost importance in the operation and servicing of the hydraulic system. Of equal importance is the avoidance of nicks and burrs on any of the working parts.

LUBRICATION AND BLEEDING

All Models

192. Capacity of hydraulic reservoir is 3.0 gallons and IH "Hy-Tran" fluid is recommended. If "Hy-Tran" fluid is not available, the following oils may be used. Below 32 degrees F, SAE-10 engine oil; 32 degrees F to 80 degrees F, SAE-20 engine oil and above 80 degrees, SAE-30 engine oil.

To bleed system, fill reservoir to bottom of filler hole then start engine and cycle system until all air is bled from system. Recheck reservoir fluid level and add fluid as required.

TROUBLESHOOTING

Series B-275

193. The following troubleshooting chart lists troubles which may be encountered in the operation and servicing of the Series B-275 hydraulic lift system. The procedure for correcting many of the causes of trouble is obvious, however, for those not so obvious, refer to the appropriate subsequent paragraphs.

Install a gage capable of registering at least 2500 psi in the lower plug (15—Fig. 138) hole before starting system check.

A. System unable to lift load. High gage pressure. Could be caused by:
   1. Isolating valve closed.
   2. System overloaded.
   3. Linkage restricted.

B. System unable to lift load or load raises slowly. Gage shows little or no pressure. Could be caused by:
   1. Suction filter clogged.
   2. Insufficient fluid in system.
   3. Faulty pump.
   4. Main valve not seating.

C. Erratic or sluggish operation. Could be caused by:
   1. Insufficient fluid in system.
   2. Suction filter clogged.

D. System will not hold load in raised position with control lever at neutral. Could be caused by:
   1. Incorrect non-return valve tappets setting.
   2. Leakage past piston or through thermal relief valve.
   3. "O" ring on isolating valve damaged.
   4. Oil leaking through non-return valve.

E. System will not lower. Could be caused by:
   1. Incorrect non-return valve tappet setting.
   2. Linkage restricted.

F. Excessive operating pressure. Could be caused by:
   1. Faulty or malfunctioning main valve.

Series B-414-424-444-2424-2444-354-364-384

194. The following troubleshooting chart lists troubles which may be encountered in the operation and servicing of the 424, 444, 2424, 2444, B-414, 354, 364 and 384 hydraulic lift system. The procedure for correcting many of the causes of trouble are obvious, however, for those not so obvious, refer to the appropriate subsequent paragraphs.

A. System will not lift with either draft or position control.
   1. System overloaded.
   2. Faulty relief valve
   3. Regulator piston stuck open.
   4. Speed control piston stuck open.
   5. Faulty hydraulic pump.

B. System lifts slowly.
   1. System overloaded.
   2. Faulty hydraulic pump.
   3. Suction filter plugged.
   4. Speed control piston stuck in slow position.
   5. Faulty relief valve.
   6. Low oil level in reservoir.

C. System will not hold load.
   1. Piston seal leaking.
   2. Thermal relief valve in piston leaking (if so equipped).
   3. Control valve or cylinder "O" rings leaking.
   4. Internal parts of control valve leaking.

NOTE: Turn isolator valve in and if lift arms stop settling, leak is in control valve. If lift arms continue to settle, leak is in work cylinder.

D. System will lift with one control lever but not the other.
   1. Faulty or maladjusted control linkage.
   2. Position control plunger binding.

E. System noisy.
   1. Air in system.
   2. Suction filter plugged.
   3. Oil level in reservoir low.

F. System overheats.
   1. Relief valve operating continuously.
   2. High pressure line restricted.
   3. Air in system.
   4. Operating fluid contaminated.

G. Oil discharges through relief valve with lift arms fully raised.
   1. Regulator piston stuck in closed position.
   2. Control lever stop incorrectly adjusted.
   3. Orifice or orifice filter plugged.

H. Lift arms creep up when operating external cylinder.
   1. Isolator valve not fully closed.
   2. Isolator valve leaking.

TESTING

Series B-275

195. When testing, all connections and mounting surfaces should be clean and free of dirt or other foreign material. Remove filler plug and check fluid level. Fluid should reach bottom of filler hole. Refill if necessary. If fluid is excessively low, check level of oil in crankcase to see if there is leakage from pump into crankcase.

Remove lower plug from left end of control valve and install a gage capable of registering at least 2500 psi. Connect lower links to a weight of at least 1250 pounds and measure to see that the lower link ends are approximately 10 inches from the ground. Start engine, place control lever in raise position and check the time required for the system to reach full lift. This time should be approximately 1½ seconds.

With engine running, control lever in raised position and with load fully raised, the pressure gage should read 2050-2250 psi. A lower reading indicates an inefficient pump or a malfunctioning pressure relief valve.

With system in raised position, place control lever in "Hold" position and let unit set for about 3 minutes. During this 3 minutes the lower links should not drop more than 1/16-inch when measured at extreme ends. If the 1/16-inch drop is exceeded, oil may be leaking past the piston or through the non-return valve. Close the isolating valve and recheck. If lower links continue to fall, oil is leaking past the piston, the non-return valve "O" ring or the thermal relief valve which is incorporated into the piston. If the lower links remain stationary, oil is leaking through the non-return valve.

Start engine and place control lever in raise position. Allow engine to run at full throttle for about 3 minutes and check all connections and mounting surfaces for leaks. Return control lever to neutral and stop engine. Recheck reservoir level and crankcase level for evidence of leakage into engine crankcase. Remove pressure gage and reinstall lower plug in control valve.

Series B-414-424-444-2424-2444-354-364-384

196. When testing, all connections and mounting surfaces should be clean and free of dirt or other foreign material. Remove filler plug and check fluid level. Fluid should reach bottom of hole. Refill if necessary. If fluid is excessively low, check level of oil in engine crankcase to see if there is leakage of oil from pump into crankcase.

Prior to testing lift system, connect at least 1250 pounds of weight to hitch. Open isolating valve and set the draft control (outside) lever to the deepest (full forward) position. Place speed control knob in the "Slow" lift position, slowly raise lift with position control lever until the distance between centerline of top pin on hitch lower link attaching plate and centerline of lift arm pin is 24½ inches, then move position control lever stop until it firmly contacts rear of lever and tighten stop in this position. Check this setting by lowering and raising the lift arms again with the position control lever. It should not be possible to raise the hitch an additional ½-inch by moving the draft control lever to the shallowest (rear) position. Return draft control lever to deepest position.

Install a gage capable of registering at least 3000 psi in the accessory plug hole (right hand plug) in the front side of control valve cylinder head. Now run engine at rated rpm and be sure position control lever is in full lower (forward) position. Close the isolator valve, then move the draft control lever to the shallowest position and note the gage reading as the relief valve opens. This reading should be 2300-2400 psi.

CAUTION: Do not maintain this test for more than 20 seconds as damage to hydraulic system could result.

If the observed gage reading is not as specified and the relief valve is operating, a faulty relief valve indicated and relief valve spring should be checked.

NOTE: Late production relief valves are shim adjusted. Installing one additional shim behind relief valve spring will increase relief pressure approximately 50 psi.

If the observed gage reading is not as specified and the pressure relief valve is not operating, either the flow control valve spool is stuck in the fully opened position or the hydraulic pump is faulty. Before removing gage, make a back pressure test as follows: Place draft control lever in deepest position and the position control lever in full down position and observe gage which should have a zero reading. If condition is not as stated, check for bent, damaged, worn or maladjusted linkage.

Hydraulic system operation can be further checked as follows: With isolator valve open and hitch in fully lowered position, place speed control knob in "Fast" position and move position control lever to lift position. Hitch should raise to full lift in not more than two seconds. Move the position control handle slowly forward and check to see that it is possible to control the rate of drop so that at least five seconds are required for a full drop. Move the speed control knob to "Slow" position, move the position control lever to lift position and check the time required for the hitch to raise to full lift. This time should be three to four seconds.

Raise hitch to full lift position and close the isolator valve. Move the position control lever to lower position and check drop of hitch. The hitch should not drop more than 0.005 in thirty seconds. Open isolator valve.

Again place hitch in full lift position, if necessary, then move position control lever to mid-position. Check the hitch drop which should be not more than 0.005 in thirty seconds. Move the position control lever to lower position and check height of lower link ends above the ground. Lower link ends must be not more than five inches from ground.

Secure the position control lever stop about mid-way of the quadrant, fully raise hitch, then move position control lever forward until it contacts stop. Measure and record the height of lower link ends from ground. Now fully lower hitch, then raise it until the position control lever is in the same position and against the same side of the stop as it was when hitch was lowered. Again measure height of lift link ends from ground and if this measurement differs more than one inch from the first measurement, plunger spring (17—Fig. 143) is faulty and should be renewed.

PUMP

Series B-275

197. R&R AND OVERHAUL. To remove the hydraulic pump, remove the Allen screws from suction and pressure line manifolds. Remove the cap screws retaining pump to crankcase front cover plate and remove pump.

To disassemble the removed pump, straighten tab washer (2—Fig. 133), remove nut (1) and using a suitable puller, or a soft faced hammer, remove gear from shaft (14). Remove the eight cap screws and lift cover assembly (7) from pump body (16). At this time, note the location of pressure relief plate (10). Prior to removing same, remove "O" ring (8). Remove snap ring (3), oil seal washer (5) and oil seal (6).

NOTE: Bearings (12) may stay with cover or may remain in pump body. In either case they may be withdrawn by moving one out slightly in advance of the other. Be sure not to lose the small locking wires.

Drive shaft (14) and driven shaft (13) can now be removed. Disassembly can

be completed on pumps as shown in Fig. 133 by removing name plate (19), snap rings (18), sealing plugs (17) and bumping out bearings (15). On those pumps which do not include items (17) and (18), bearings can be removed using a hooked tool.

With pump disassembled, inspect all parts for burrs, scoring, wear or other damage. Bearing faces can be refinished providing they are only lightly scored.

When reassembling, use new drive shaft oil seal and "O" rings. Install bearings as follows: Hold bearing together with flats in engagement and locking wires in position. Start bearings into their bores with one bearing slightly in advance of the other. Push bearings into bores until first bearing bottoms, rotate bearings in the direction of pump rotation, then press second bearing into bore until it bottoms. Be sure pressure relief plate and relief plate "O" ring are positioned on inlet side of pump body and prior to installing pump cover, place a straightedge across machined face of pump body and measure the distance between straightedge and pressure relief plate. This distance should not be less than 0.003 nor more than 0.0055. Various sized pressure relief plates are available to obtain this distance.

Balance of reassembly is obvious. Reinstall pump, then fill and bleed system as outlined in paragraph 192.

Series B-414-354-364-384 And Series 424-444-2424-2444 Diesel

198. **R&R AND OVERHAUL.** To remove the hydraulic pump, remove the Allen screws from suction and pressure line manifolds. Unbolt pump from engine front cover and remove pump.

To disassemble the removed pump, straighten tab washer (1—Fig. 134), remove nut and using a suitable puller, or a soft faced hammer, remove gear from shaft (8). Place a scribe line across length of pump, remove the four through-bolts and separate pump. The "O" rings (5) and (6) can now be removed from cover (12) and flange (4). Bearings (7) and the drive and driven gears and shafts (8 and 9) can now be removed from pump body (11) by gently bumping ends of shafts.

NOTE: When removing the bearing assemblies (7) be sure to note which side the cut-outs in bearings are positioned and be sure bearings are in the same position when reinstalling. The smallest cut-out must be on the pressure side of the pump.

With pump disassembled, inspect all parts for burrs, scoring, wear or other damage. Bearing faces can be refinished providing they are only slightly scored. Use all new "O" rings and drive shaft oil seal when reassembling.

Reassemble by reversing the disassembly procedure and be sure to align the previously affixed scribe line. Refer to Fig. 135 and note how "O" rings are installed in pump cover. "O" rings in pump mounting flange are installed in a similar manner. Reinstall pump, then fill and bleed the hydraulic system as outlined in paragraph 192.

199. Series 354, 364, 384 and late Series B-414 tractors, serial number 21196 and later, equipped with power steering, use the dual pump shown in Fig. 136. The removal and disassembly of this pump is similar to the procedure outlined in paragraph 198 for the single pump.

Series 424-444-2424-2444 Non-Diesel

200. **R&R AND OVERHAUL.** To remove the hydraulic pump, drain the hydraulic system and remove the two bolts securing the manifold flange to pump. Unbolt pump from engine crankcase and remove pump.

200A. To disassemble the Cessna pump, first remove nut, drive gear and key from pump shaft. Place a scribe line across length of pump to assure proper reassembly. Remove the two remaining cap screws, then bump pump shaft against a wood block to separate front plate (9—Fig. 137) from rear housing (1). Withdraw gear and shaft assemblies (3 and 12) and thrust plate (2) from rear housing. Using a sharp tool, pry diaphragm (4) from diaphragm seal (7). Identify the check ball hole and remove spring (11) and check ball (10). Lift nylatron gasket (5), protector gasket (6) and diaphragm seal (7) from front plate (9). Remove pump shaft oil seal (8).

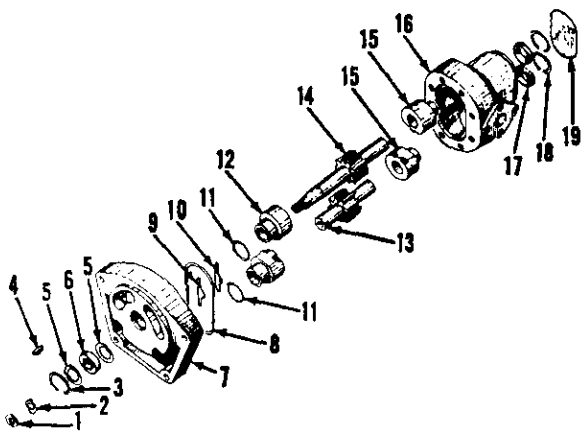


Fig. 133—Exploded view of the Series B-275 engine driven hydraulic pump. Some pumps do not include items (17) and (18).

1. Nut
2. Lockwasher
3. Snap ring
4. Woodruff key
5. Seal washer
6. Oil seal
7. Pump cover
8. "O" ring
9. "O" ring
10. Pressure relief plate
11. "O" rings
12. Bearings
13. Driven gear
14. Drive gear
15. Bearings
16. Pump body
17. Sealing plugs
18. Snap rings
19. Name plate

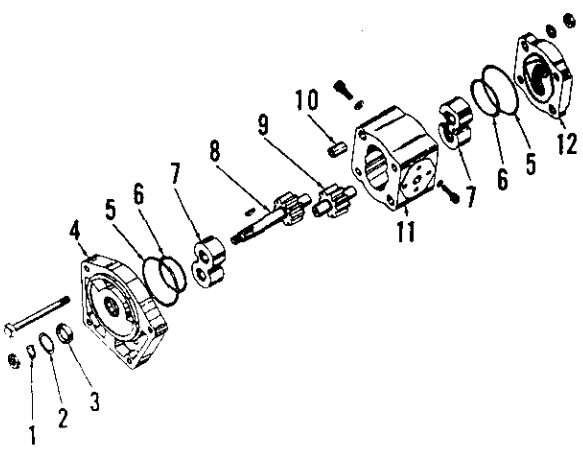


Fig. 134—Exploded view of hydraulic pump used on Series B-414, 354, 364 and 384 tractors not equipped with power steering and Series 424, 444, 2424 and 2444 diesel tractors.

1. Lockwasher
2. Snap ring
3. Oil seal
4. Pump flange
5. "O" ring
6. "O" ring
7. Bearing
8. Drive gear & shaft
9. Driven gear & shaft
10. Dowel
11. Pump body
12. End cover

Fig. 135—Hydraulic pump cover showing installation of "O" rings. Pump flange will be similar.

Check all parts for burrs, scoring, wear or other damage.

4.5 GPM Pump

O.D. of shafts at bushings ..... 0.5605 min.
I.D. of bushings in body and cover ..... 0.5655 max.
Gear width ..... 0.376 min.
I.D. of gear pocket in body .. 1.404 max.

9 GPM Pump

O.D. of shafts at bushings ..... 0.5605 min.
I.D. of bushings in body and cover ..... 0.5655 max.
Gear width ..... 0.748 min.
I.D. of gear pocket in body ..... 1.404 max.

When reassembling, use new diaphragm, nylatron gasket, protector gasket, diaphragm seal, thrust plate and shaft oil seal. These parts are available as a service package (IH part number 381002R92). With open part of diaphragm seal (7) towards front plate (9), work same into grooves of front plate using a dull tool. Press the protector gasket (6) and nylatron gasket (5) into the relief in the diaphragm seal. Install check ball (10) and spring (11) in front plate, then install diaphragm (4) with bronze face toward gears. Entire diaphragm must fit inside raised rim of diaphragm seal. Dip gear and shaft assemblies in oil and install them in front plate. Position thrust plate (2) in rear housing (1) with the bronze side toward gears and the half moon cut-out on inlet side of pump. Install rear housing over pump gears, then install cap screws. Lubricate the shaft seal (8) and carefully work seal over drive gear shaft. Seat the shaft seal by tapping with a plastic hammer. Check the pump rotation. Pump should have a slight amount of drag but should rotate evenly.

After reinstalling the pump drive gear, reinstall pump on tractor, then fill and bleed the hydraulic system as outlined in paragraph 192.

200B. To disassemble the Thompson pump, first remove the nut, drive gear and key from pump shaft. Place a scribe line across length of pump to assure proper reassembly. Remove the two remaining cap screws, then bump the pump shaft against a wood block to separate front cover from pump body. Remove gears and shafts, bearings and bearing spring plate, identifying all parts so they can be reassembled in the same position. Any further disassembly will be evident after examination of unit. Small nicks and/or scratches can be removed from body, cover, shafts, gears and bearings by using crocus cloth or a fine oil stone.

Check pump for excessive wear using the following specifications:

9 GPM Pump

O.D. of shafts at bearings ..... 0.624 min.
I.D. of bearing bore ..... 0.632 max.
I.D. of gear pocket in body ..... 2.651 max.
Gear width ..... 0.599 min.

When reassembling, lubricate all parts with clean Hy-Tran fluid, or its equivalent, and renew all seals and "O" rings. A hydraulic pump "O" ring and gasket package (IH part number 368634R92) is available for this pump.

Reinstall pump on tractor, then fill and bleed the hydraulic system as outlined in paragraph 192.

CONTROL VALVE

Series B-275

201. **R&R AND OVERHAUL.** To remove the control valve, drain the hydraulic system reservoir, then remove the quadrant strip. Disconnect pressure line, and if so equipped, the remote control line, from the control valve. Unbolt and remove control valve. If necessary, use a screwdriver to separate control valve from lift cylinder as it is being removed.

Disassemble the removed control valve as follows: Refer to Fig. 138, remove cap screws from isolating valve (4) stop plate and unscrew isolating valve. Remove plug (6) or remote control line coupling, if so equipped. Remove plug (20), washer (19), spring (18) and dashpot piston (17). Remove plugs (15 and 31) and their washers. Loosen jam nut (35) on intercouple lever adjusting screw (34) and remove adjusting screw from intercouple lever. Place control lever in lift position so that intercouple lever is clear of non-return valve (10). Place a screwdriver through non-return valve hole, lift intercouple lever and at the same time place control lever in lower position. This will withdraw relief valve (27) from intercouple lever and allow intercouple lever to be removed. Remove the intercouple lever spring (13) then

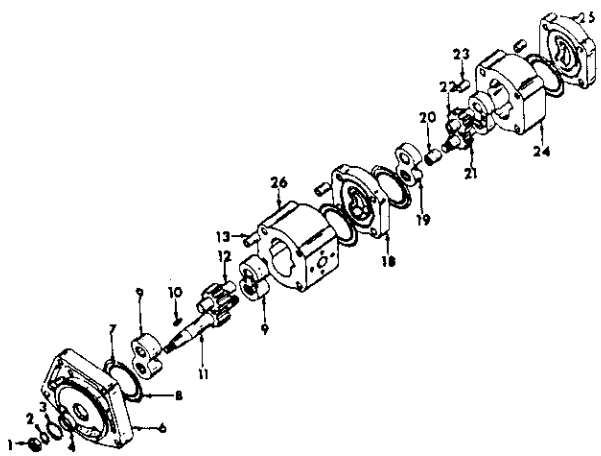


Fig. 136—Exploded view of dual hydraulic pump used on late Series B-414, 354, 364 and 384 tractors equipped with power steering.

1. Nut
2. Lock
3. Snap ring
4. Oil seal
6. Pump flange
7. "O" ring
8. "O" ring
9. Bearing
10. Key
11. Drive gear
12. Driven gear
13. Dowel pin
18. Center plate
19. Bearing
20. Coupling
21. Drive gear
22. Driven gear
23. Dowel pin
24. Rear body
25. Rear cover
26. Front body

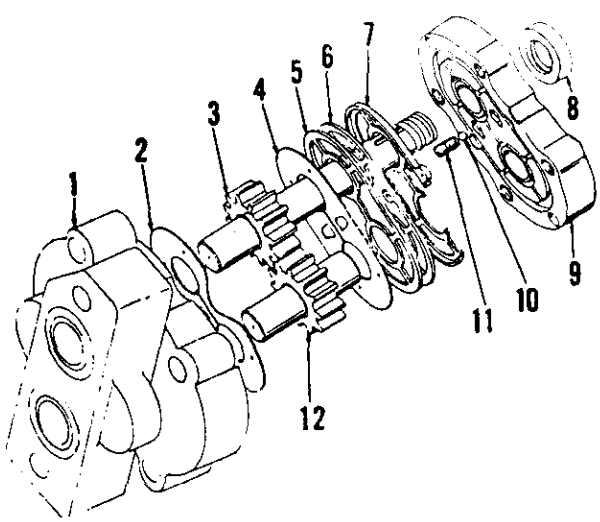


Fig. 137—Exploded view of the Cessna hydraulic pump used on Series 424, 444, 2424 and 2444 non-diesel tractors.

1. Rear housing
2. Thrust plate
3. Drive gear
4. Diaphragm
5. Nylatron gasket
6. Protector gasket
7. Diaphragm seal
8. Oil seal
9. Front plate
10. Steel ball
11. Spring
12. Idler gear

unscrew the non-return valve seat (12), valve (10), washer (11), spring (9) and stop plate (8). Remove end cover (21) and gasket (22), then remove pin (2) and withdraw control lever (1) from cam (23).

CAUTION: During the removal and disassembly of the relief valve assembly, care must be exercised to prevent bodily injury. **Should the spring stirrup (25) spread open and release the relief valve, the valve will fly out with considerable force due to the spring compression. DO NOT stand in line with relief valve assembly when working on same.**

Pull relief valve assembly out of housing far enough to remove cam (23) from cam stirrup (24), then either install a 1¼-in. I.D. safety collar over spring stirrup (25) or wrap same with wire to insure against spring stirrup spreading and allowing relief valve to fly. Now pull relief valve assembly from housing.

Do not disassemble the relief valve assembly unless necessary. However, should it prove to be necessary, proceed as follows: Support closed end of spring stirrup in a press, place a hollow mandrel or a piece of pipe over stem of relief valve and take up slack. Slide safety collar up over mandrel, or loosen wire wrapping, then depress spring and spread stirrup. Slowly release pressure and separate relief valve assembly.

Use a tool similar to that shown in Fig. 139 and remove relief valve seat (28—Fig. 138) and washer (29).

202. Thoroughly clean all parts and inspect valves and seats for scoring, pitting or undue wear. Inspect all springs for rust, distortion or fractures. Inspect all other parts for undue wear or damage. Relief valve spring can be checked against the following specifications.

Free length . . . . . 3-7/8 in.
Test length . . . . . 2¾ in.
Test load at 2¾ in. . . . . 231-245 lbs.

Approximate free lengths of the remaining springs shown in Fig. 138 are as follows: Intercouple lever spring (13), 7/8-inch; non-return valve spring (9), 11/16-inch; dashpot spring (18), 13/16-inch.

203. Reassemble by reversing the disassembly procedure, however, keep the following points in mind: If new valves and/or seats are being installed the mating faces should be lightly lapped to insure against leakage. Renew seat washers (11 and 29—Fig. 138) and all "O" rings. Cam (23) is installed with "V" cut-out toward outside of housing as shown in Fig. 140.

With unit assembled and prior to installing plug (15—Fig. 138), adjust intercouple lever adjusting screw (34) a as follows: Place control lever in neutral position, turn adjusting screw in until it just touches the non-return valve, then back-off screw ⅓-turn and tighten jam nut (35). Install plug (15).

204. Reinstall control valve to reser-

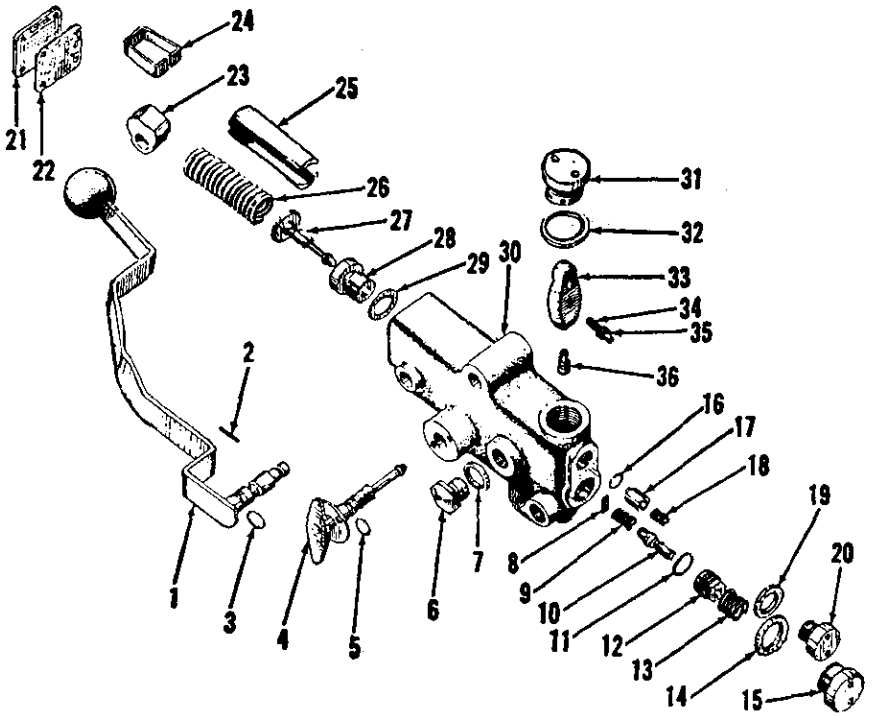


Fig. 138—Exploded view of the B-275 series hydraulic control valve. A remote coupling attachment may be installed instead of plug (6).

1. Control lever & shaft
2. Pin
3. "O" ring
4. Isolating valve
5. "O" ring
6. Plug
7. Washer
8. Valve stop
9. Spring
10. Non-return valve
11. Copper washer
12. Valve seat
13. Spring
14. Washer
15. Plug
16. Snap ring
17. Dashpot piston
18. Spring
19. Washer
20. Housing plug
21. End cover
22. Gasket
23. Cam
24. Cam stirrup
25. Spring stirrup
26. Relief valve spring
27. Relief valve
28. Valve seat
29. Copper washer
30. Valve body
31. Plug
32. Washer
33. Intercouple lever
34. Socket set screw
35. Jam nut
36. Ball end

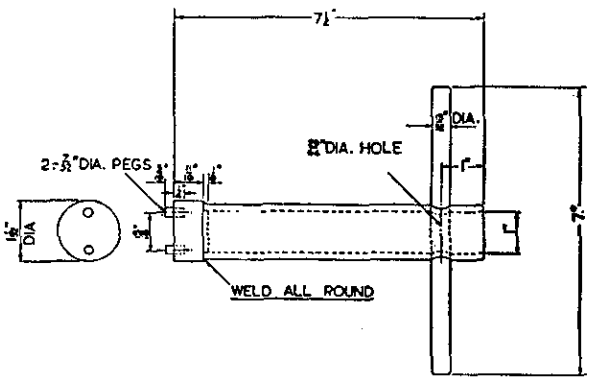


Fig. 139—View showing dimensions of special tool used to remove relief valve seat of the control valve shown in Fig. 138.

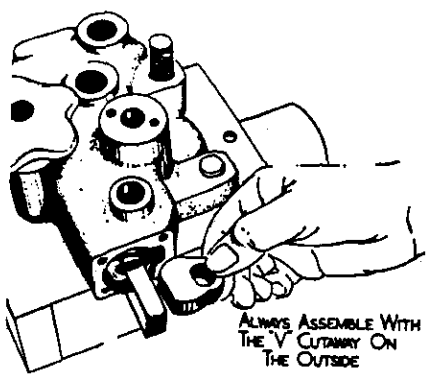


Fig. 140—When installing cam in cam stirrup, position "V" cutout as shown.

voir, then fill and bleed system as outlined in paragraph 192.

CONTROL VALVE CYLINDER HEAD

Series B-414-424-444-2424-2444-354-364-384

205. **R&R AND OVERHAUL.** To remove the control valve cylinder head, either remove the complete hydraulic housing as outlined in paragraph 209, or drain housing, remove retaining cap screws, then raise front of housing far enough for control valve cylinder head to clear transmission top cover and support in this position with wood blocks. Remove the cap screws which retain the cylinder head and control valve to lift housing and separate cylinder head from control valve. Catch spacer (9—Fig. 143) and spring (10) as the units are separated.

With cylinder head removed, refer to Fig. 141 and proceed as follows: Remove adapter pressure line (coupling) and spacer (14). Remove snap ring (28) and pull plug (25) and "O" ring (26), speed control piston spring (22) and speed control piston (21) from bore. Unscrew latch (29) and remove speed control spool assembly (items 23, 24, 27, 29 and 30). Remove plug (3) and washer (4), then remove orifice and screen (5) and "O" ring (6).

NOTE: Orifice and screen assembly will generally remain in its position in the control valve flange.

Remove cap screws from isolating valve stop plate (8), then unscrew and remove isolating valve assembly (items 7 through 13). Auxiliary plug (1) need not to be removed unless cleaning is indicated. Any further disassembly required will be obvious, however, be sure to note and identify "O" rings (17, 18, 19 and 20) and their locations.

Inspect all parts for burrs, scoring, wear or other damage. Speed control piston should be a snug fit in its bore yet slide freely. Speed control piston spring should have a free length of 2.51 inches and should test 10 lbs. when compressed to a length of 1.625 inches.

Use all new "O" rings and reassemble by reversing the disassembly procedure. Reinstall cylinder head to control valve and hydraulic lift housing to rear frame, then fill and bleed the hydraulic system as outlined in paragraph 192.

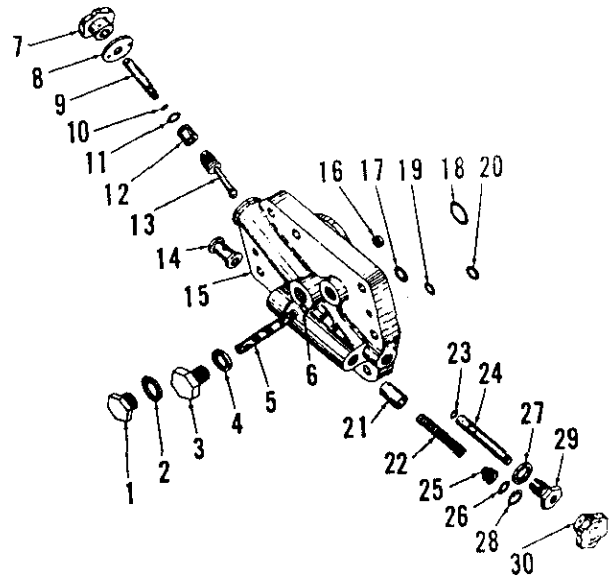
CONTROL VALVE

Series B-414-424-444-2424-2444-354-364-384

206. **R&R AND OVERHAUL.** To remove the control valve, either remove the complete hydraulic housing as outlined in paragraph 209 or drain housing, remove hydraulic housing retaining cap screws, then raise front of housing and support with a wood block. Remove auxiliary valve cover plate from left front of lift housing and pull the return tube. Tube is internally threaded and a cap screw can be used

Fig. 141—Exploded view of hydraulic control valve cylinder head.

1. Plug
2. Seal washer
3. Plug
4. Seal washer
5. Orifice assembly
6. "O" ring
7. Knob
8. Stop plate
9. Shaft
10. "O" ring
11. "O" ring
12. Bushing
13. Isolator valve
14. Spool (spacer)
15. Cylinder head
16. Plug
17. "O" ring
18. "O" ring
19. "O" ring
20. "O" ring
21. Speed control piston
22. Piston spring
23. "O" ring
24. Speed control spool
25. Plug
26. "O" ring
27. Seal washer
28. Snap ring
29. Spool latch
30. Knob



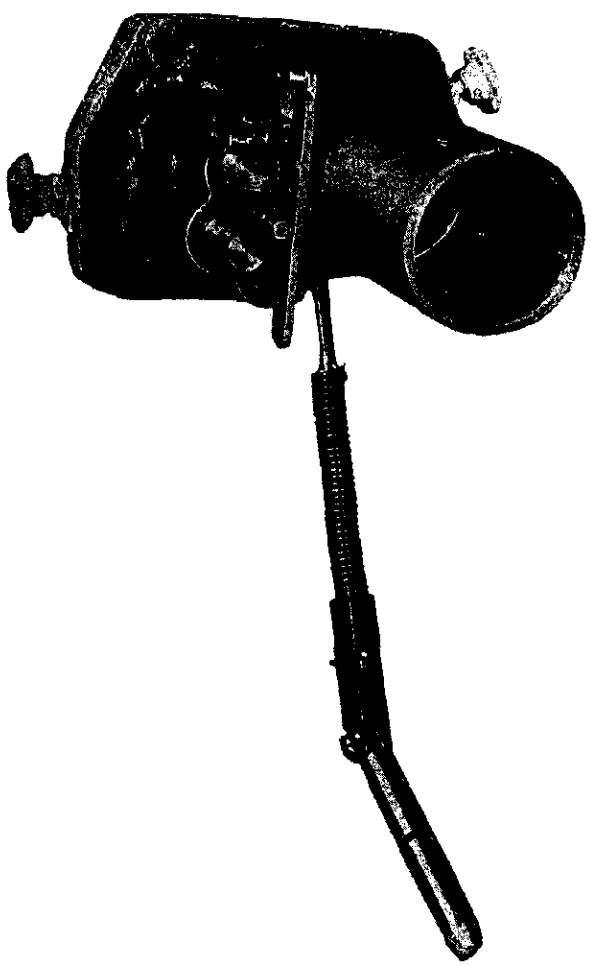


Fig. 142—Control valve assembly and draft plunger linkage after removal from hydraulic lift housing.

to assist in pulling tube. Disconnect valve operating link from draft control shaft crankshaft. Disconnect draft link plunger return spring and on models so equipped, disconnect draft control spool safety chain. Remove the retaining cap screws and pull control valve, cylinder head and cylinder assembly from housing. See Fig. 142. Remove the valve operating link, radius arm and the draft link plunger assembly from control valve. Remove the two small cap screws and separate cylinder head from control valve which will release spacer (9--Fig. 143) and spring (10). Remove spring seat and lowering spool (11) from control valve flange (body). Remove plunger (19) and plunger spring (17). Remove the internal snap ring (25) and draft spool (24).

NOTE: To remove snap ring (25), disengage and work ends into bore which will cause snap ring to extend above end of bore where it can be grasped.

Remove snap ring (35) and withdraw plug (33) and "O" ring (34). Withdraw piston (31) and "O" ring (32). Use International Harvester tool FES 10-28, or its equivalent, and remove valve seat (29) and "O" ring (30). Remove flow control ball (28), ball rider (27) and spring (26). Unscrew relief valve spring housing (46) and remove relief valve spring (45), ball rider (44) and relief valve ball (43). Remove relief valve ball seat (41) and "O" ring (42), spacer (39), spring (40), non-return ball (38), ball seat (37) and copper washer (36).

At this point, sleeve (12), gland (14), sleeve (18), plug (22) and sleeve (23) are still in the valve body bores. They can be pressed from the bores if necessary. Sleeve (18) is shouldered and must be removed toward front of valve body. Be sure to renew all "O" rings if these parts are removed.

Cylinder (2) can be pressed from flange of valve body, if necessary. An International Harvester crankshaft rear oil seal driver (FES 6-15) or a piece of pipe of proper diameter can be used for this operation, however, take care not to damage the machined surface of valve body flange.

Clean all parts in a suitable solvent and blow out all oil passages. Use compressed air to dry parts. DO NOT use rags as lint could clog filters or lodge between valves and seats causing them to malfunction.

Inspect all parts for nicks, burrs or scoring. Nicks and burrs may be dressed with a fine stone, however, if any dressing is done, be extremely careful not to remove any of the sharp edges of spools or valve seats. No adjustments are available for this valve. Renew any parts which are the least bit doubtful and refer to the following table for the spring specifications.

Lubricate parts prior to assembly, then reassemble and reinstall control valve by reversing the disassembly and removal procedures. Reinstall hydraulic lift housing, then fill and bleed hydraulic system as outlined in paragraph 192.

RESERVOIR AND COMPONENTS

Series B-275

The hydraulic lift system reservoir is fitted over the differential portion of the transmission case (rear frame) and forms the top cover of that portion. Incorporated within the reservoir are the rockshaft assembly, work cylinder and piston, a spring loaded depth control, a by-pass filter and a suction filter. In addition, the hydraulic control valve is bolted to the left front face of the reservoir directly over the work cylinder. See Fig. 144 for an exploded view of reservoir and rockshaft assembly.

207. **REMOVE AND REINSTALL.** To remove the hydraulic reservoir unit, proceed as follows: Drain reservoir by disconnecting suction line hose. Disconnect quadrant strip from control lever

Spring	Call-out Fig. 143	Free Length	Test Lbs. at In.
Position plunger	17	1.038	7-9 at ¾
Flow control	26	1.439	15.8-17.5 at 1-1/32
Non-return valve	40	1-1/8 to 1¼	4.74 at 5/8
Position spool (B-414)	10	2-5/32	24-29.4 at 1-3/16
Position spool (all other models)	10	2.53	37 at 2
Relief valve	45	2.88	85.5-94.5 at 2.568

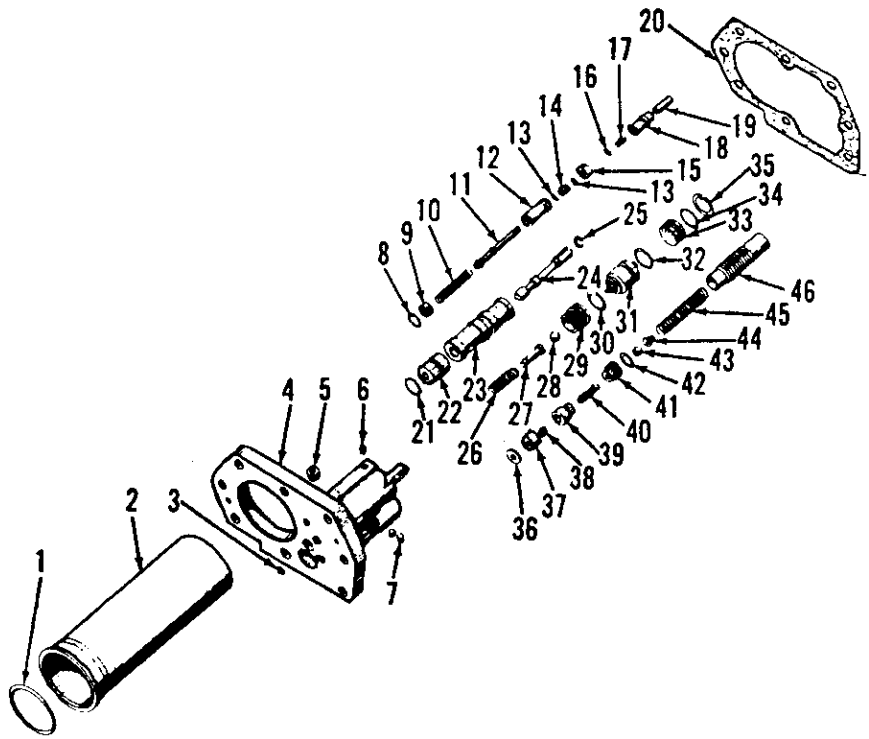


Fig. 143—Exploded view of the B-414, 354, 364, 384, 424, 444, 2424 or 2444 series hydraulic lift system control valve. Spacer (9) used on early Series B-414 units.

1. "O" ring
2. Cylinder
3. "O" ring
4. Valve body
5. Pipe plug
6. Pipe plug
7. Pipe plug
8. "O" ring
9. Spacer
10. Spring
11. Lowering spool
12. Sleeve
13. "O" ring
14. Spool gland
15. Plug
16. "O" ring
17. Spring
18. Sleeve
19. Plunger
20. Gasket
21. "O" ring
22. Plug
23. Sleeve
24. Draft spool
25. Snap ring
26. Spring
27. Ball rider
28. Flow control valve ball
29. Seat
30. "O" ring
31. Piston
32. "O" ring
33. Plug
34. "O" ring
35. Snap ring
36. Copper washer
37. Seat
38. Non-return valve ball
39. Sleeve
40. Spring
41. Seat
42. "O" ring
43. Relief valve ball
44. Ball rider
45. Relief valve spring
46. Spring housing

quadrant. Disconnect pressure line and if so equipped, the remote line coupling, from control valve. Unbolt and remove control valve and if necessary, use a screwdriver to separate control valve from work cylinder. Remove seat. Disconnect lift linkage from rockshaft arms and reservoir, then unbolt and remove the reservoir and rockshaft unit.

208. **OVERHAUL.** To disassemble and/or overhaul the reservoir and rockshaft unit after it has been removed as outlined in paragraph 207, proceed as follows: Unbolt and remove control lever quadrant, then pull suction filter and attached pipe from housing. Use a cap screw, if necessary, and pull the by-pass filter from housing, then remove piston (27—Fig. 144) from cylinder (19). Remove cylinder from housing. Unbolt depth control support (38) from housing, turn unit until key on spring housing aligns with slot in housing, then remove unit. Remove cap screws and retainers (15), then remove lift arms (9) from rockshaft (6). Turn unit over so cover plate (2) is on top side, then remove cover plate and gasket. Pull cotter pin from connecting rod pin (4) and remove pin and connecting rod (17). Remove clamping bolts from depth control cam (5) and rocker arm (3), then using a lead hammer, drive rockshaft from housing.

NOTE: During removal of the rockshaft, the oil seal (14), washer (12) and in most cases, bushing (11) will be pushed out as rockshaft emerges. Oil seal, washer and bushing can be removed from opposite side after rockshaft is out.

Any further disassembly required will be evident upon examination of the units. If thermal relief valve is removed from piston, be extremely careful not to lose the small steel ball (30). Free length of spring (28) is 11/16-inch and spring should test 12.4 lbs. when compressed to a length of ½-inch.

Clean all parts and examine for any undue wear or damage. It is always good policy to renew bushings (11) when housing is stripped as these bushings receive the greatest amount of wear and are the least accessible.

When reassembling the reservoir and rockshaft assembly, use all new "O" rings, gaskets and oil seals. The only seal that should be considered for reuse is the piston seal (13) and then only if it shows no signs of wear or damage. To install oil seals (14) use special tool provided by International Harvester, or a piece of shim stock and be sure seals fit over major diameter of rockshaft.

Reassemble reservoir and rockshaft unit by reversing disassembly procedure, reinstall on tractor, then fill and bleed system as outlined in paragraph 192.

Series B-414-424-444-2424-2444-354-364-384

The hydraulic reservoir (Fig. 145) is fitted over the differential portion of the transmission case (rear frame) and forms the top cover of that portion. Incorporated within the reservoir are the rockshaft assembly, work cylinder and piston, the control valve assembly, the position and draft control operating and sensing linkage and a suction filter. See Fig. 146 for a view of the position and draft control operating and sensing linkage.

209. **REMOVE AND REINSTALL.** To remove the rockshaft and reservoir

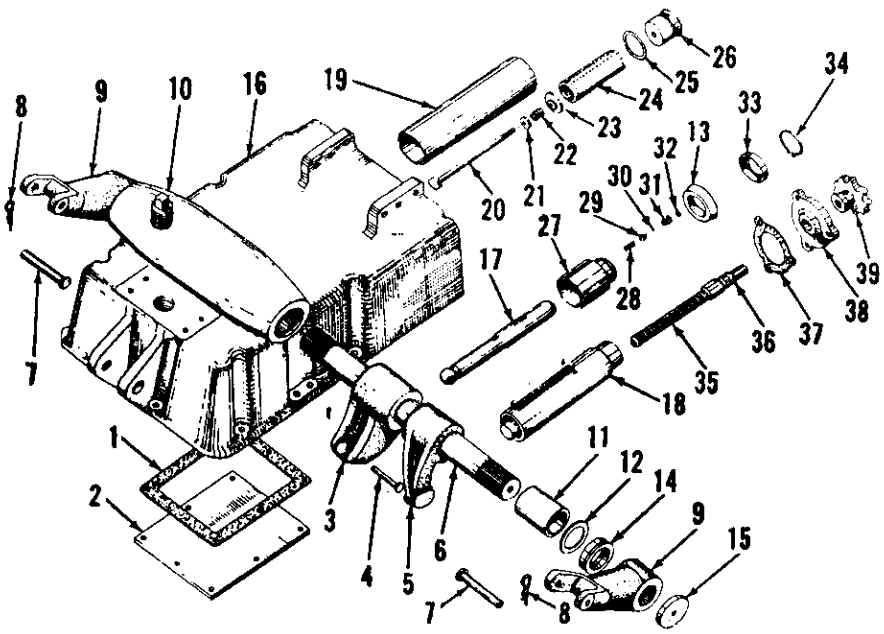
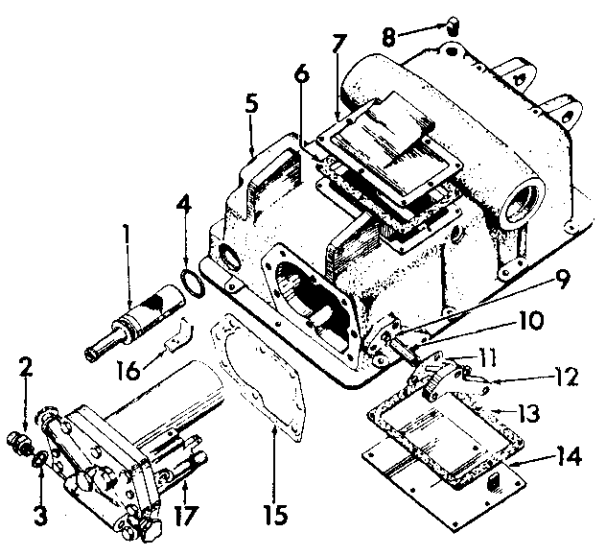


Fig. 144—Exploded view of the Series B-275 reservoir, rockshaft and their component parts. Items 28 through 32 comprise the thermal relief valve.

1. Gasket
2. Cover plate
3. Rocker arm
4. Pin
5. Depth control cam
6. Rockshaft
7. Pin
8. Cotter pin
9. Lift arm
10. Filler plug
11. Bushing
12. Washer
13. Piston seal
14. Oil seal
15. Retainer
16. Housing
17. Connecting rod
18. Depth control spring assembly
19. Cylinder
20. Bolt
21. Washer
22. Spring
23. Spring seat
24. By-pass filter
25. "O" ring
26. Filter body
27. Piston
28. Spring
29. Ball rider
30. Ball
31. Plug
32. "O" ring
33. Seal retainer
34. Snap ring
35. Screw
36. Seal ring
37. Gasket
38. Support
39. Hand wheel

Fig. 145—Typical hydraulic lift reservoir used on Series B-414, 354, 364, 384, 424, 444, 2424 and 2444. Refer to Fig. 146 for control linkage and Fig. 148 for the rockshaft assembly.



1. Suction filter
2. Connector
3. Sealing washer
4. "O" ring
5. Lift housing (reservoir)
6. Gasket
7. Top cover
8. Filler & level plug
9. "O" ring
10. Return tube
11. Gasket
12. Auxiliary valve cover
13. Gasket
14. Bottom cover
15. Gasket
16. Filter retainer
17. Control valve assembly

(lift unit) assembly, first drain reservoir by removing drain plug at right rear of housing, or by loosening clamps of suction line coupling hose and sliding hose forward on suction line. Disconnect pressure line, and if so equipped, the remote cylinder line from the control valve cylinder head. Disconnect lift links from rockshaft lift arms and the upper link from draft control bellcrank. Remove seat. Remove reservoir retaining cap screws, attach hoist to unit and lift same from rear frame.

When placing unit on work bench, be sure draft spring assembly is beyond edge of bench, or support unit with blocks.

210. **OVERHAUL.** Overhaul of all control and sensing linkage except the draft control spindle and spring assembly can be accomplished without removing the hydraulic lift unit from tractor.

To remove the rockshaft and/or rockshaft bushings, rocker arm or rockshaft cam, refer to paragraph 213.

For information relating to control valve cylinder head, refer to paragraph 205 and for control valve, refer to paragraph 206.

211. QUADRANT, LEVERS AND SHAFTS. The quadrant, control levers and control lever shafts can be removed and serviced as follows: Drain reservoir and remove seat. Remove housing top cover. Disconnect position control link (21—Fig. 146) from position control sleeve (16), then unbolt quadrant bracket from housing and pull quadrant and control levers and shafts from housing.

To disassemble unit, remove quadrant strip from quadrant and nut from outer end of draft control shaft. Remove levers (3 and 7), friction discs (4 and 6) and locating washer (5). If necessary, remove quadrant from bracket. Remove snap ring (8) from outer end of position control sleeve, pull shaft assembly from bracket, then remove "O" ring (12) from inner bore of bracket. Use a press, or a valve spring compresser, and pressing on end of draft control shaft (27), compress spring (22) enough to allow removal of snap ring (23). Carefully release pressure and pull draft control shaft from position control sleeve.

The position control tube (19) can be removed from housing after removal of the cross tube pivots (17).

Any further disassembly required will be obvious. Renew any damaged, worn or bent parts.

Use new "O" rings and gaskets and reassemble by reversing the disassembly procedure. Be sure to mate the correlation marks of control levers and shafts when installing levers on shafts and enter pin on draft control crankshaft in its hole in the draft link (29) when installing quadrant assembly.

212. DRAFT CONTROL LINKAGE. To completely service the draft control linkage will require removal of lift unit as outlined in paragraph 209.

Remove lock plate (31—Fig. 146), then pull pivot pin (32) and remove bellcrank (33). Remove locknut from top of trunnion (34), then unscrew spindle (41) from trunnion. All springs and spring seats are now free. Remove the spindle oil seal from bore in bottom of housing.

Inspect all parts for damage or undue wear and renew as necessary. Spring and pivot pin specifications are as follows: Upper draft control spring has a free length of 2.170 inches and should test 1000 lbs. at 1.937 inches. Lower draft control spring has a free length of 5-3/16 inches and should test 3100-3500 lbs. when compressed to a length of 4-11/16 inches. Pivot pin (32) has a diameter of 0.996-1.000 and pivot pin hole in bellcrank has an inside diameter of 1.002-1.005 which gives the pivot pin a normal operating clearance of 0.002-0.009.

Reinstall and adjust the draft control spring assembly as follows: Install new oil seal in spindle bore in bottom of housing. Place spring seat (39), spring (35) and trunnion (34) in their position on housing, then insert spindle (41) and screw it into trunnion until shoulder on spindle contacts spring seat (39) and all slack is taken out of assembly but DO NOT compress the spring. Install and tighten locknut. Install top spring seat (42), spring (43), bottom spring seat and retaining nut. Tighten nut until all slack is taken out of assembly but DO NOT compress spring. Install cotter pin.

NOTE: It is important that all slack be removed from spring assemblies but the springs must not be compressed.

Mate slots of bellcrank and pins of trunnion and install bellcrank pivot pin and lock plate.

With unit assembled as outlined, place draft control lever in its deepest position and measure distance between end of draft link plunger (38) and operating pad of bellcrank. This distance should be 3/8 to 13/32-inch as shown in Fig. 147. If measurement is not as stated, bring to correct dimension by adding flat washers as shown.

Reinstall lift unit on tractor by reversing the removal procedure.

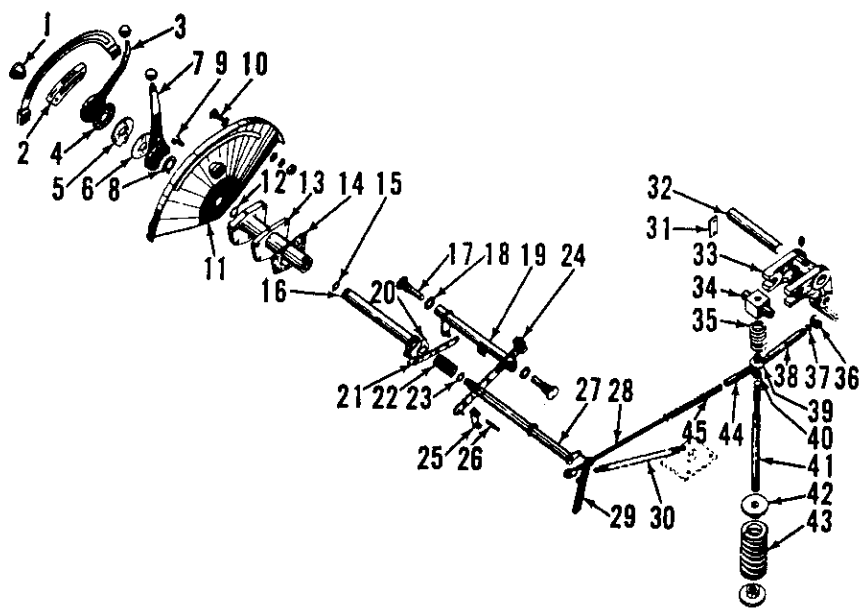


Fig. 146—Exploded view of control levers, quadrant and the draft and position control linkage.

1. Stop nut
2. Slide
3. Draft control lever
4. Friction disc
5. Friction plate
6. Friction disc
7. Position control lever
8. Snap ring
9. Lever stop
10. Bolt (stop)
11. Quadrant
12. "O" ring
13. Bracket
14. Gasket
15. "O" ring
16. Position control sleeve
17. Cross tube pivot
18. Seal washer
19. Cross tube
20. Tab washer
21. Connecting link
22. Spring
23. Snap ring
24. Position control link
25. Radius arm
26. Pivot pin
27. Draft control crankshaft
28. Draft link
29. Operating link
30. Return spring
31. Lock plate
32. Bellcrank pivot pin
33. Bellcrank
34. Trunnion
35. Spring
36. Oil seal
37. "O" ring
38. Plunger
39. Spring seat
40. Oil seal
41. Spindle
42. Spring seat
43. Spring (draft)

213. ROCKSHAFT. To remove the rockshaft (6—Fig. 148), remove the lift unit as outlined in paragraph 209. Remove both lift arms from rockshaft. Turn unit bottom side up, remove housing bottom cover and disconnect draft plunger link return spring. On models so equipped, disconnect draft control spool safety chain. Remove the connecting rod. Remove lock bolt from rocker arm, then bump rockshaft from left to right and remove rockshaft from right side of housing. Rocker arm (7) and rocker cam (8) can be lifted from housing.

NOTE: Rockshaft right hand bushing, washer and oil seal will come out with rockshaft and left hand bushing and oil seal assembly can be driven out after rockshaft is out.

Inspect all parts for damage and undue wear. Renew parts as necessary. Rockshaft and rockshaft bushings specifications are as follows: Rockshaft bushing journal diameter, 2.248-2.250. Rockshaft bushings inside diameter, 2.251-2.253. This provides a normal operating clearance of 0.001-0.005 for the rockshaft.

If necessary, the connecting rod bushing (9), located in the rocker arm, can be renewed at this time.

When reassembling, coat parts with oil, start rockshaft into housing at right side and align master spline of rockshaft with master splines of rocker arm and rocker cam. Rocker cam must be installed with chamfered bore side next to rocker arm. Install bushings and oil seals after rockshaft is positioned and use a seal driver when installing seals to insure against seal damage.

Reinstall unit on tractor by reversing the removal procedure. Fill and bleed hydraulic system as outlined in paragraph 192.

214. WORK CYLINDER AND PISTON. To service the work cylinder and piston, remove the control valve as outlined in paragraph 206. With control valve out, remove valve cylinder head and bump piston from cylinder head. On Series B-414 and early Series 424 and 2424, remove snap ring, seal retainer and seal from piston. On late Series 424 and 2424 and all Series 354, 364, 384, 444 and 2444, an "O" ring (12—Fig. 148) and a back-up ring (13) are used for the piston seal.

NOTE: On all tractors except Series B-414 having serial numbers 727 to 2160 (non-diesel) and 8106 to 16650 (diesel), a thermal relief valve assembly was incorporated in the work piston.

Removal of the relief valve assembly is obvious, however, be extremely careful not to lose the small 3/32-inch steel ball. Free length of relief valve spring is 11/16-inch and spring should test 12.4 lbs. when compressed to a length of ½-inch.

The cylinder can be pressed from flange of control valve, if necessary, by placing rear of cylinder on a block and using an International Harvester crankshaft rear oil seal driver (FES 6-15), or a piece of pipe of proper diameter, positioned on valve flange over cylinder bore. Use caution during this operation not to mar the machined surface of the valve flange. Cylinder inside diameter is 3.000-3.006 for new cylinder.

REMOTE CONTROL VALVE

Series B-275-B-414

The Series B-275 and B-414 tractors have available a double acting remote control valve which mounts on the scuttle panel (lower instrument panel) and provides hydraulic control for trailed implements.

215. **R&R AND OVERHAUL.** Removal of the remote control valve is obvious.

To overhaul the removed valve, refer to Fig. 149 and proceed as follows: Disconnect and remove link (12) from valve spool and lever, then remove lever pivot pin and separate lever from valve housing. Remove cap (1), snap ring (2) and stop disc (3). Pull spool and centering spring assembly from valve body. Remove screw (3A) and lock washer, stop collar (4), centering spring (5) and stop washer (6) from end of valve spool, then remove spool seals (7) from spool bore. Unscrew relief valve body (15) and remove body, relief valve spring (18), spring guide (19) and ball (20) from valve body. DO NOT lose shims (17) which are located between outer end of relief valve spring and bottom of spring bore in relief valve body. Unscrew relief valve seat (21) and remove seat, "O" ring (22) and

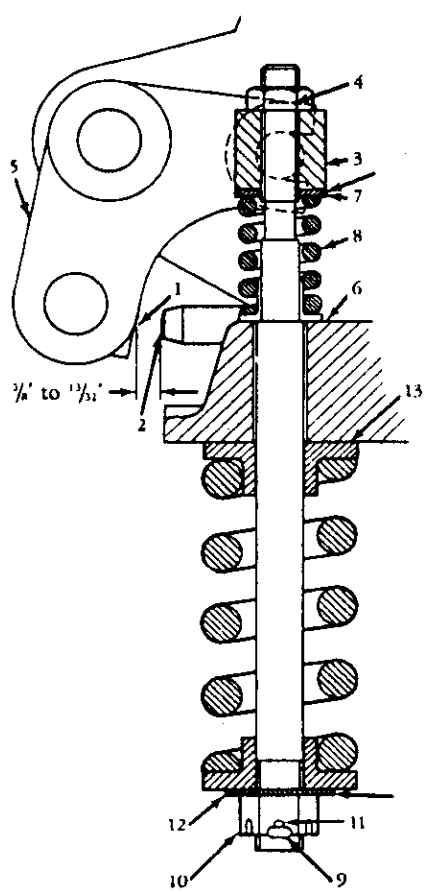


Fig. 147—After assembly, draft control spring and spindle must be adjusted as shown.

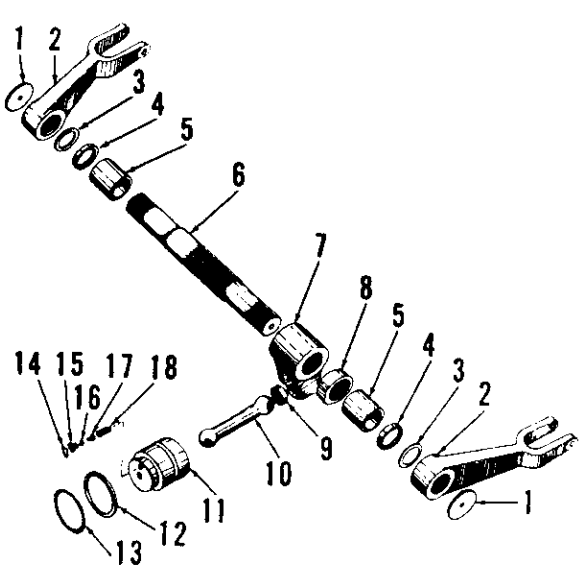


Fig. 148—View of rockshaft and components used on Series B-414, 354, 364, 384, 424, 444, 2424 and 2444 lift unit. Items 14 through 18 comprise the thermal relief valve.

1. Retaining plate
2. Lift arm
3. Washer
4. Oil seal
5. Bushing
6. Rockshaft
7. Rocker arm
8. Cam
9. Bushing
10. Connecting rod
11. Piston
12. "O" ring
13. Back-up ring
14. "O" ring
15. Relief plug
16. Steel ball
17. Ball rider
18. Spring

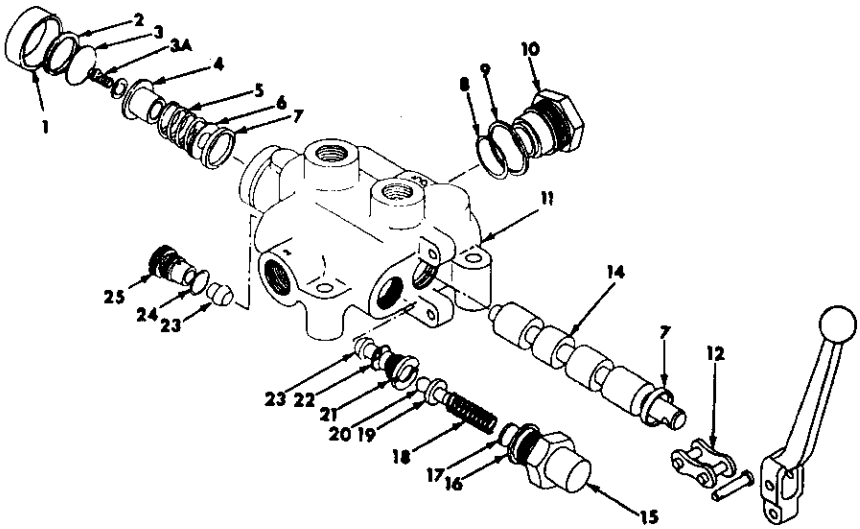


Fig. 149—Exploded view of the remote control valve which can be mounted on the scuttle plate (lower instrument panel) on Series B-275 and early Series B-414 tractors.

1. Bonnet cap
2. Snap (stop) ring
3. End cap
4. Collar stop
5. Centering spring
6. Stop washer
7. Spool seal
8. Seal
9. Gasket
10. Sleeve
11. Valve body
12. Connecting link
14. Valve spool
15. Relief valve body
16. Gasket
17. Shim
18. Spring
19. Spring guide
20. Check ball
21. Relief valve seat
22. "O" ring
23. Poppet
24. "O" ring
25. Plug

poppet (23). Unscrew plug (25) and remove plug, "O" ring (24) and poppet (23). Any further disassembly is obvious.

Wash all parts in a suitable solvent and inspect. Renew parts as necessary. Spool (14) and valve body (11) are available only as a matched set.

Relief valve spring should have a free length of 2.135 inches and should test 225-275 lbs. when compressed to a length of 1¾ inches.

Lubricate parts and reassemble by reversing disassembly procedure. Relief valve pressure of 2050-2250 psi for Series B-275 or 2200-2400 psi for Series B-414 is adjusted by varying the number of shims (17). Relief pressure can be checked by installing a pressure gage in one of the break-away couplings and directing oil to the gage by the control valve.

Series 424-444-2424-2444-B-414-354-364-384

216. **R&R AND OVERHAUL.** Removal of the auxiliary valve is obvious.

To overhaul the removed double or single acting control valves, refer to Fig. 150 and 151 and proceed as follows: Remove plug (23), then using a valve spring compressor, compress centering spring (20) and drive out roll pin (9A). Remove centering spring and spring seats then withdraw spool assembly from top of valve body. Drive out roll pin (9) and remove ball (4), rider (5), spring (6), spring seat (10) on double acting valves only (Fig. 150), and spool end (8) from spool (3). Unscrew relief valve housing (16) and remove relief valve spring (14), rider (13), ball (12) and seat (11). Using a screwdriver, pry out seal (1).

Clean and inspect all parts for excessive wear, scoring or scratches. If spool (3) or bore in valve body shows evidence of scoring or excessive wear, both parts must be renewed as they

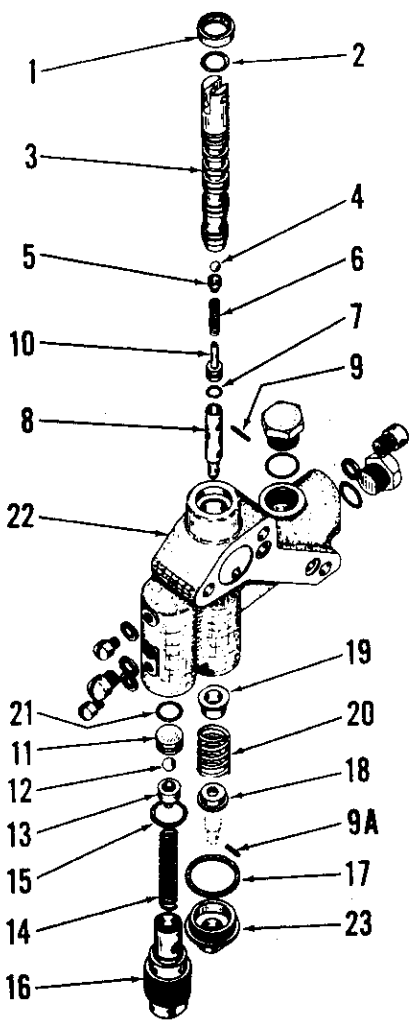


Fig. 150—Exploded view of the double acting auxiliary control valve used on Series 354, 364, 384, 424, 444, 2424, 2444 and late Series B-414 tractors.

1. Oil seal
2. "O" ring
3. Valve spool
4. Steel ball
5. Ball rider
6. Spring
7. "O" ring
8. Spool end
9. Roll pin
9A. Roll pin
10. Spring seat
11. Relief valve seat
12. Steel ball
13. Ball rider
14. Relief valve spring
15. "O" ring
16. Relief valve housing
17. Washer
18. Spring seat
19. Spring seat
20. Return spring
21. "O" ring
22. Valve body
23. Plug

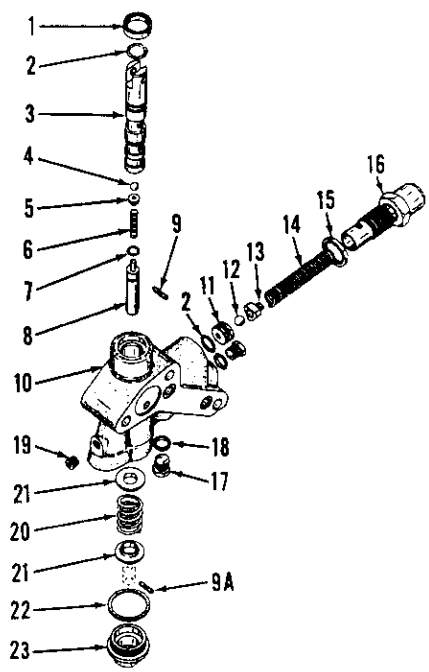


Fig. 151—Exploded view of the single acting independent auxiliary valve used on Series 384.

1. Oil seal
2. "O" ring
3. Valve spool
4. Ball
5. Ball rider
6. Spring
7. "O" ring
8. Spool end
9. Roll pin
9A. Roll pin
10. Valve body
11. Relief valve seat
12. Ball
13. Ball rider
14. Relief valve spring
15. Washer
16. Spring housing
17. Screw
18. Washer
19. Pipe plug
20. Return spring
21. Spring seat
22. Fibre washer
23. Plug

are available only as a matched set.

Relief valve spring free length is 2-27/32 inches and should exert 85-95 lbs. pressure when compressed to a length of 2.568 inches.

When reassembling, dip all parts in clean Hy-Tran oil and renew seal (1) and all "O" rings. The spool (3) must be installed in top of valve body to prevent damage to "O" ring (2). Install seal (1) after spool is installed in valve body.

Reinstall valve on tractor, then fill and bleed hydraulic system as outlined in paragraph 192.

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